United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
United States
Department of
Agriculture,
Forest Service, and
Missouri Agricultural
Experiment Station

Soil Survey of Callaway County, Missouri

How To Use This Soil Survey

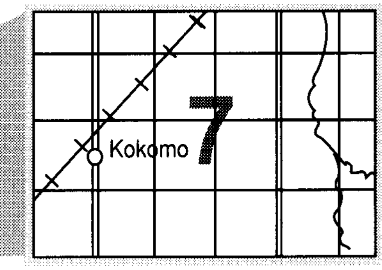
General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

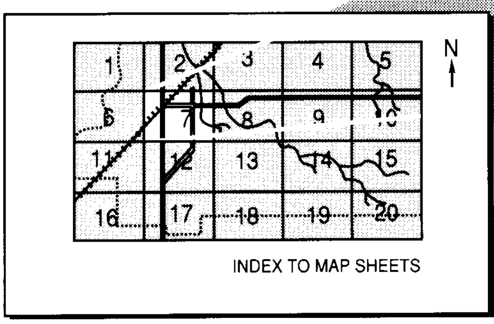
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.



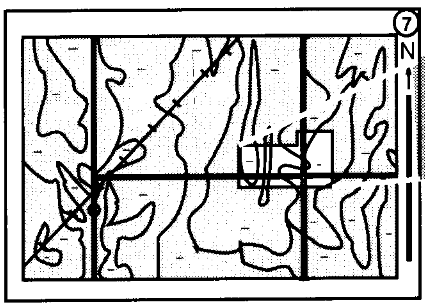
MAP SHEET

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



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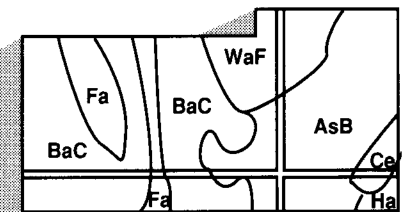

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1985. Soil names and descriptions were approved in 1986. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, and the Missouri Agricultural Experiment Station. The Missouri Department of Natural Resources provided a soil scientist to assist in the fieldwork. The Callaway County Commission through the Callaway County Soil and Water Conservation District provided funds for a soil scientist to assist in the fieldwork. The survey is part of the technical assistance furnished to the Callaway County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: An area of Winfield silt loam, 14 to 20 percent slopes, eroded, and Goss-Gasconade-Rock outcrop complex, 5 to 35 percent slopes. These map units are used mainly as woodland or pasture.

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Issued October 1992

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Callaway County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow over bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

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Soil Survey of Callaway County, Missouri

By Frederick E. Horn, Soil Conservation Service

Fieldwork by Frederick E. Horn and David W. Wolf, Soil Conservation Service,
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United States Department of Agriculture, Soil Conservation Service and Forest Service,
in cooperation with Missouri Agricultural Experiment Station

CALLAWAY COUNTY is in the central part of Missouri, at the southernmost extent of glaciation (fig. 1). It has an area of 542,355 acres, or about 847 square miles. It is bordered on the north by Audrain County, on the east by Montgomery County, on the south by Osage County, on the southwest by Cole County, and on the west by Boone County. Fulton is the county seat and the largest town in the county. In 1980, it had a population of 11,046. In that year, the population of the county was 32,252.

Although it has some nonfarm businesses and industries, the county generally is economically dependent upon farming and farm-related businesses. About 37 percent of the acreage in the county is used as cropland, 24 percent as permanent pasture, and 37 percent as forest land. About 2 percent is developed for urban uses or is covered by water. Most of the farm income in the county is derived from the sale of livestock. About 30 percent or less is derived from the sale of crops.

Corn, soybeans, and winter wheat are the principal cash crops. Beef cattle, dairy cattle, and hogs are the dominant kinds of livestock. A claypan area in the northern part of the county and the flood plains along the Missouri River in the southernmost part are used almost exclusively for cash-grain farming. The central part of the county is used for a mixture of livestock and cash-grain farming. The deeply dissected areas in the southern part produce most of the timber in the county.

Controlling erosion in sloping areas is the main management concern on the cropland in the county. On the Mexico and Armstrong soils in the prairie region, sheet erosion is a severe hazard. It also is a severe hazard on Hatton and Keswick soils in the adjoining timbered region. Winfield and Menfro soils, in areas of deep loess bordering the flood plains along the Missouri River, are subject to severe sheet and gully erosion. Putnam and Marion soils on uplands and Booker and Waldron soils on bottom land are wet.

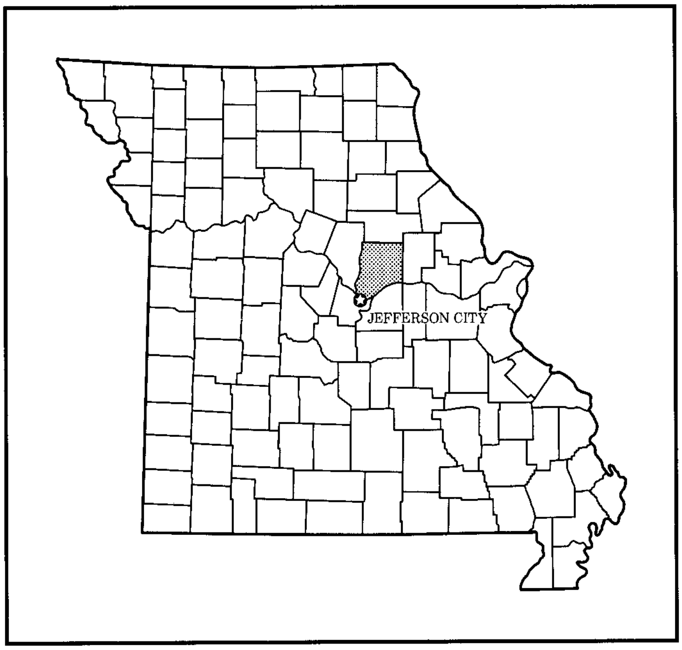

Figure 1.—Location of Callaway County in Missouri.

Irrigating the soils on most of the bottom land and those on some of the nearly level or gently sloping uplands can increase yields. The soils in many areas on the narrow bottom land along small tributary streams are well suited to walnut and other high-value trees. Menfro and Winfield soils are well suited to orchards and vineyards.

This soil survey updates the survey of Callaway County published in 1919 *(15)*. It defines the soil boundaries more clearly and provides more detailed information about the soils.

General Nature of the County

This section gives general information about Callaway County. It describes climate, natural resources, relief and drainage, and history and development.

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

The consistent pattern of climate in Callaway County is one of cold, wet winters and long, hot, dry summers. Heavy rains occur mainly in spring and early summer, when moist air from the Gulf of Mexico interacts with drier continental air. The annual rainfall is normally adequate for corn, soybeans, and all grain crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Fulton, Missouri, in the period 1951 to 1981. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 30 degrees F and the average daily minimum temperature is 20 degrees. The lowest temperature on record, which occurred at Fulton on January 13, 1974, is -15 degrees. In summer, the average temperature is 75 degrees and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred on July 15, 1954, is 116 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 35.38 inches. Of this, nearly 22 inches, or about 62 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 16 inches. The heaviest 1-day rainfall during the period of record was 4.76 inches at Fulton on September 16, 1969. Thunderstorms occur on about 51 days each year. Tornadoes and severe thunderstorms occur occasionally but are local in extent and of short duration. They cause damage in scattered small areas. Hailstorms occur in scattered small areas during the warmer part of the year.

The average seasonal snowfall is about 21 inches. The greatest snow depth at any one time during the period of record was 12 inches. On the average, 14 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 12 miles per hour, in spring.

Natural Resources

Soil and its associated crops and woodland are the most important natural resources in Callaway County. Many products are derived either directly or indirectly from the soil. These include crops, livestock, wood, fruits, vegetables, and honey. All are produced on farms and then marketed. The thick mantle of soil is suitable for many kinds of construction and waste disposal. The kinds of construction material in the county include topsoil, sand, and gravel.

Water is another abundant resource. The Missouri River forms the southern boundary of the county. It provides an abundance of good surface water to municipal and industrial users. Barge traffic on the river provides an easy means of transporting farm products to market and of shipping industrial output. Irrigation systems in areas of cropland on the flood plain along the Missouri River utilize both river and ground water. The Missouri River and its tributaries also provide opportunities for recreation.

Surface storage of water in the county also is important. Water for livestock is available in most areas of the county. The larger bodies of water provide opportunities for fishing. Large irrigation reservoirs are increasing in number and importance in the gently sloping uplands of the county.

Mineral resources include limestone, commercial sand and gravel, refractory clay, and coal. Limestone is used as a road base and soil amendment and in the manufacture of concrete. Large amounts of sand and gravel are dredged out of the Missouri River. The tributary streams also are sources of gravel. Refractory clay is mined for the production of firebricks. Old strip mines that were once mined for coal cover large acreages, but no active mines remain.

The southern part of the county is rich in timber and wildlife. In many areas hardwoods of commercial quality are abundant. Wildlife, including deer and wild turkey, prosper in the wooded areas.

Relief and Drainage

Callaway County has a number of major physiographic regions. Alluvial flood plains adjacent to the Missouri River are along the south and southwest boundaries of the county. A band of forested hills borders the flood plains. The next band, which runs approximately across the southern one-third of the county, consists of dominantly forested soils that formed in glacial till and material weathered from bedrock. The northern two-thirds of the county consists dominantly of prairie soils that formed in loess of varying thickness over glacial till.

Elevation ranges from about 500 feet above sea level in an area where the Missouri River flows out of the southeast corner of the county to about 960 feet in an area on the drainage divide between Auxvasse and Cedar Creeks in the northwestern part of the county. Local relief in the dissected southern part of the county ranges to as much as 320 feet per quarter mile. In contrast, the northern part of the county has differences in elevation of only 20 to 40 feet per one-half mile.

Surface water in an area in the north-central part of the county drains into the Salt River watershed in Audrain County and eventually into the Mississippi River. This area makes up about 2 percent of Callaway County. The water in an area in the northeastern part of the county drains into the Loutre River watershed and flows into Montgomery County. This area makes up about 16 percent of Callaway County. The remaining 82 percent of the county is drained directly into the Missouri River. The major tributaries of the river are Auxvasse Creek, Cedar Creek, Little Auxvasse Creek, and the Middle River.

History and Development

The history of land use began in the survey area with the Paleo Indians, nomadic hunters and gatherers who inhabited the area from about 10,000 to 8000 B.C. The Mississippian people used the land for agricultural purposes between A.D. 900 and 1700. These were the predecessors of the Osage, Iowa, Kickapoo, Pottawatomie, Sioux, Sac, and Fox Indians, whom the European explorers contacted after 1700 *(4)*.

Settlement of Callaway County began in the early 1800's. The first settlement was established in 1808. This was Cote sans Dessein, a steep-sided plain along both the Osage River and the Missouri River *(5)*.

The original land survey of Callaway County was conducted in 1816-17. Following this, the U.S. Government offered the land for sale and thus initiated the major immigration into the county. Areas settled first included the bottom land and the wooded areas near the major rivers and streams. The grassland in the northern part of the county was foreign and appeared barren to the settlers, who had been raised in wooded New England or the South. Therefore, the prairie was often the last area settled.

Agriculture in Callaway County was based on human and animal labor before World War I. The county had 13,338 horses in 1910, compared to 1,433 in 1982. Corn, wheat, hay, fruit, and tobacco were the most common crops in areas that were cleared of timber *(20, 21)*.

Following World War I, advances in mechanization and farming practices increased agricultural production and slowly changed the characteristics of the farms. The number of farms decreased from a high of 3,502 in 1910 to 1,381 in 1982. People moved from rural to urban areas. With the increased capability of farm machinery, fewer farmers did the farm work and in general produced more crops on fewer acres. Corn production decreased as less silage was required for farm animals, but winter wheat and hay production increased. During the 1940's, soybeans became a major crop *(4)*.

Less than 1 percent of the acreage in Callaway County is urban land. About 1.9 percent is administered by the Forest Service as the Cedar Creek Purchase Unit. Approximately 41 percent of the cropland is farmed under a system of no-till or minimum till *(8)*.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The description, names, and delineations of the soils identified on the general soil map in this survey do not fully agree or join with those of the soils identified on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local variations. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping these soils separately.

Soil Descriptions

1. Mexico-Armstrong Association

Deep, very gently sloping to strongly sloping, somewhat poorly drained soils formed in loess, pedisediments, and glacial till; on uplands

This association consists of soils on a partly loess-covered glacial till plain that occurs as broad ridges separating the high major drainage divides and the broad ridges and gradually steepening side slopes below the plain. These soils formed under prairie vegetation.

This association makes up about 24 percent of the county. It is about 69 percent Mexico soils, 20 percent Armstrong soils, and 11 percent minor soils (fig. 2).

Mexico soils are very gently sloping and gently sloping. They are on the crests of upland ridges and on long side slopes. Typically, the surface layer is very dark grayish brown silt loam. The next layer is dark grayish brown and red silty clay loam that has coatings of brown silt loam. The subsoil is dark grayish brown, mottled silty clay loam and silty clay in the upper part and grayish brown, mottled silty clay loam in the lower part. The substratum is light brownish gray, mottled clay loam.

Armstrong soils are moderately sloping and strongly sloping. They are on the convex side slopes below Mexico soils. Typically, the surface layer is very dark grayish brown loam. The subsoil is dark yellowish brown clay loam in the upper part, reddish brown clay and multicolored clay in the next part, and light brownish gray, yellowish brown, and dark yellowish brown, mottled clay loam in the lower part.

Minor in this association are Belknap, Haymond, Moniteau, and Putnam soils. The somewhat poorly drained Belknap, well drained Haymond, and poorly drained Moniteau soils are on flood plains. They are silty. The nearly level, poorly drained Putnam soils are on the highest and broadest ridgetops.

Nearly all of this association is used for corn, soybeans, or small grain. Some small areas are used for hay and pasture.

Controlling water erosion and improving or maintaining fertility and tilth are the main management concerns in the areas used for crops. Wetness can hinder spring tillage and fall harvest in the less sloping areas.

The erosion caused by overgrazing is the major concern in managing the pastured areas. In areas that do not have flowing water, ponds provide water for livestock. Wetness during spring and fall is a management concern in the less sloping areas.

The major soils are suitable for building site development. A high shrink-swell potential in the clayey subsoil and the wetness are severe limitations on building sites. Because of slow permeability, these soils

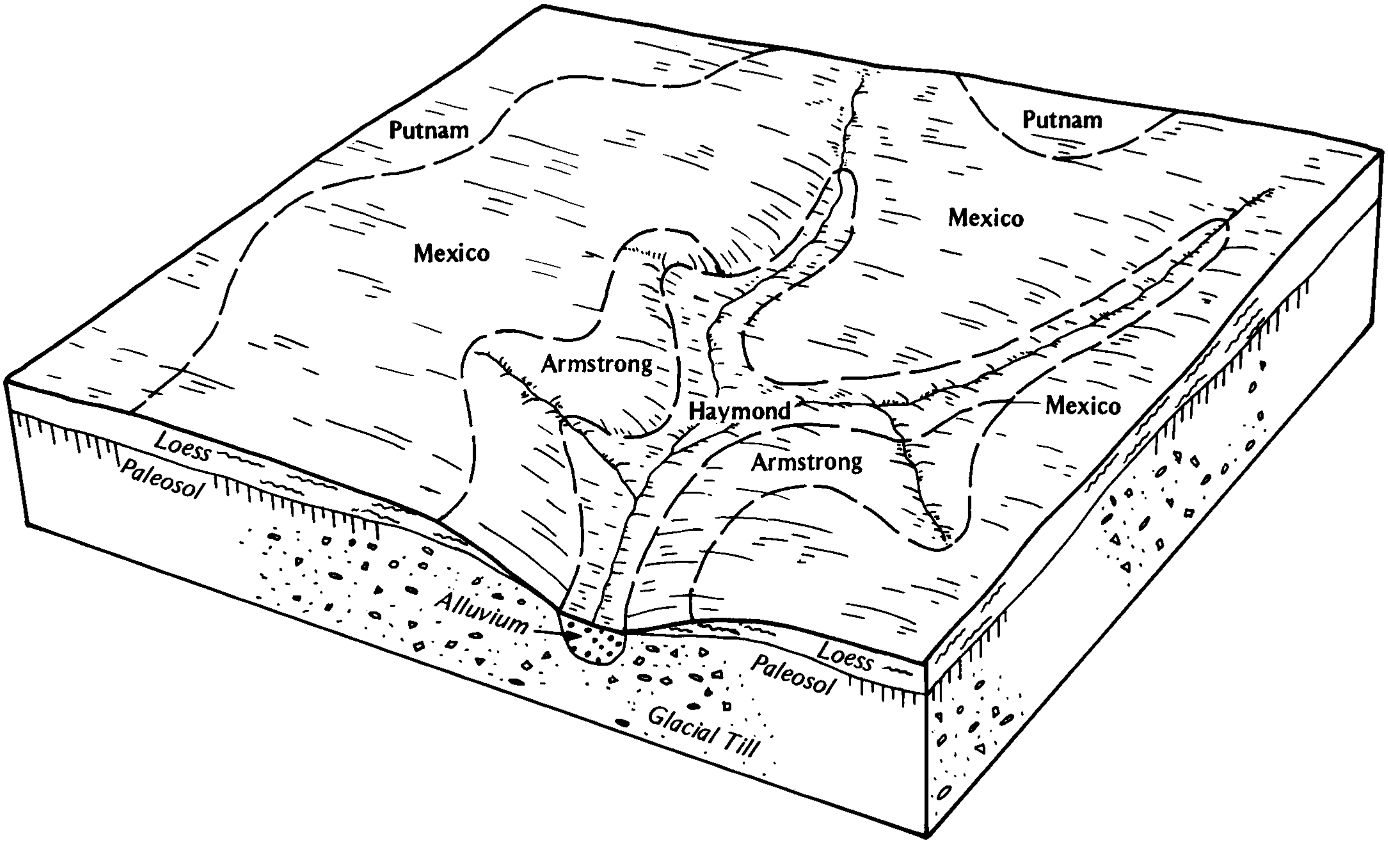

Figure 2.—Typical pattern of soils and parent material in the Mexico-Armstrong association.

are poorly suited to septic tank absorption fields. They generally are better suited to sewage lagoons.

2. Keswick-Lindley-Gorin Association

Deep, gently sloping to steep, well drained to somewhat poorly drained soils formed in loess, pedisediments, and glacial till; on uplands

This association consists of soils on narrow ridgetops, on convex side slopes, and in narrow, dissected drainageways. These soils formed primarily under forest vegetation.

This association makes up about 30 percent of the county. It is about 49 percent Keswick soils, 19 percent Lindley soils, 16 percent Gorin soils, and 16 percent minor soils (fig. 3).

Keswick soils are moderately sloping and strongly sloping and are moderately well drained. They are on convex side slopes above Lindley soils. Typically, the surface layer is dark brown loam. The upper part of the subsoil is dark brown, dark yellowish brown, and strong brown, mottled clay loam. The next part is mottled dark brown, red, yellowish brown, and grayish brown clay loam. The lower part is yellowish brown, mottled clay loam and clay. The substratum is mottled yellowish brown, dark brown, light brownish gray, and dark yellowish brown clay loam.

Lindley soils are strongly sloping to steep and are well drained. They are on the convex side slopes of highly dissected, narrow ridges and in narrow, dissected drainageways. Typically, the surface layer is very dark gray loam or clay loam. The subsurface layer is brown, mottled loam. The subsoil is strong brown clay loam in the upper part and strong brown and yellowish brown, mottled clay loam in the lower part. The substratum is strong brown, mottled clay loam.

Gorin soils are gently sloping and moderately sloping and are somewhat poorly drained. They are on narrow ridgetops and the upper side slopes above Lindley and Keswick soils. Typically, the surface layer is very dark gray silt loam. The subsurface layer is brown silt loam. The subsoil is brown, mottled silty clay loam in the upper part; brown, mottled silty clay loam and silty clay in the next part; and grayish brown and brown, mottled silty clay loam in the lower part.

Minor in this association are Calwoods, Haymond, and Landes soils. The gently sloping, somewhat poorly drained Calwoods soils are on the broader ridgetops. The well drained Haymond and Landes soils are on bottom land.

About 20 percent of this association remains forested with native hardwoods, dominantly oak and hickory. Many gently sloping or moderately sloping areas have been cleared and are used as pasture. Many of the ridgetops and a few of the upper side slopes are used as cropland.

The forested part of this association is in areas that are too steep or too dissected to be cleared and farmed. Stand improvement is needed if the best timber production is to be obtained. Because of the steep slope, the use of logging equipment is restricted and erosion is a hazard along logging roads and skid trails.

Controlling water erosion and improving or maintaining the organic matter content, fertility, and tilth are the main management concerns in the areas used for crops. The erosion caused by overgrazing is the major management concern in the pastured areas. In areas that do not have flowing water, ponds provide water for livestock.

The less sloping major soils are suitable for building site development. A moderate or high shrink-swell potential in the clayey subsoil and the wetness are limitations on building sites. Because of slow permeability, these soils are poorly suited to septic tank absorption fields. They generally are better suited to sewage lagoons.

3. Goss-Gasconade Association

Deep and shallow, moderately sloping to very steep, well drained and somewhat excessively drained soils formed in cherty and clayey limestone residuum; on uplands

This association consists dominantly of cherty and flaggy soils on hillsides and ridgetops. Differences in

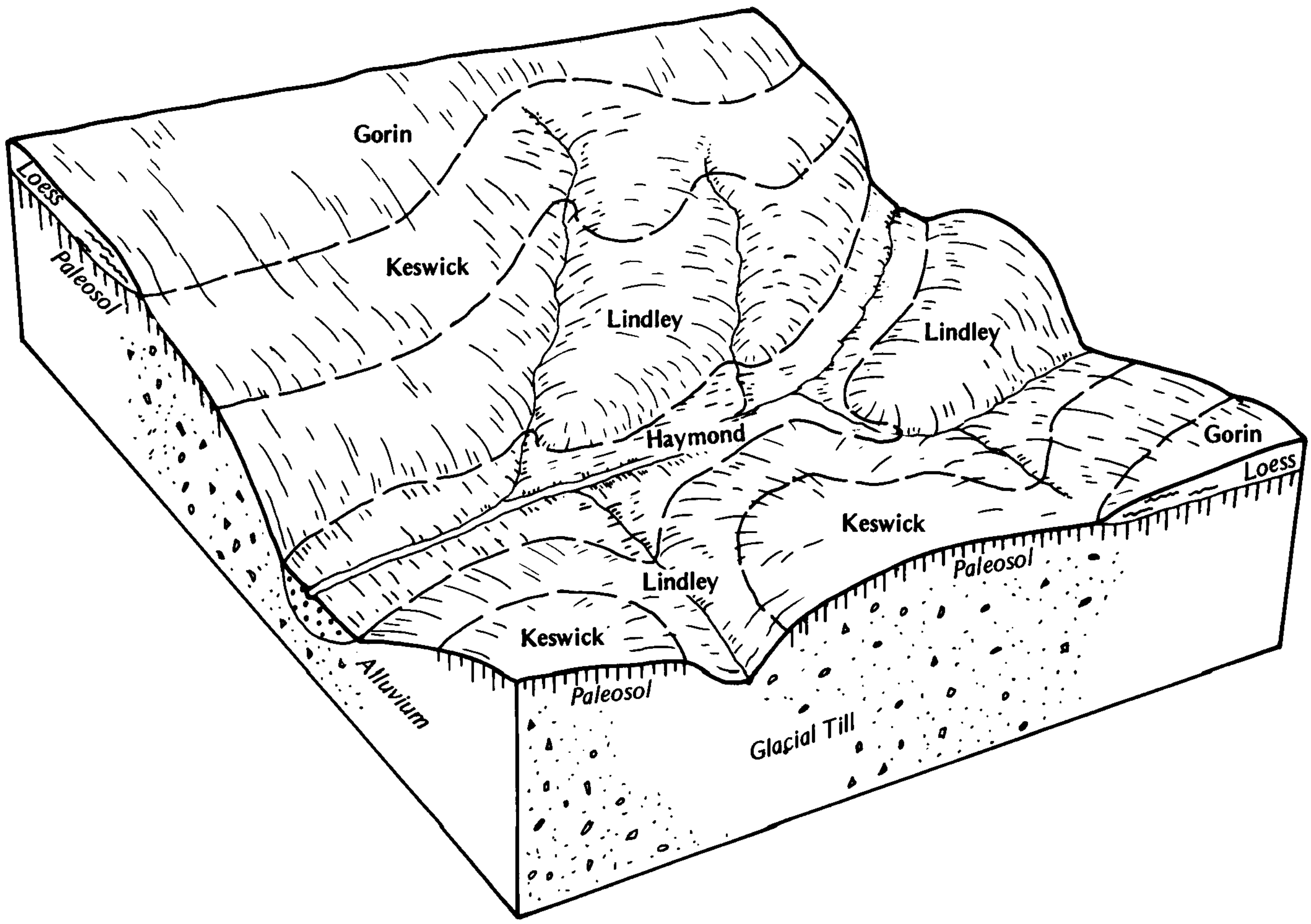

Figure 3.—Typical pattern of soils and parent material in the Keswick-Lindley-Gorin association.

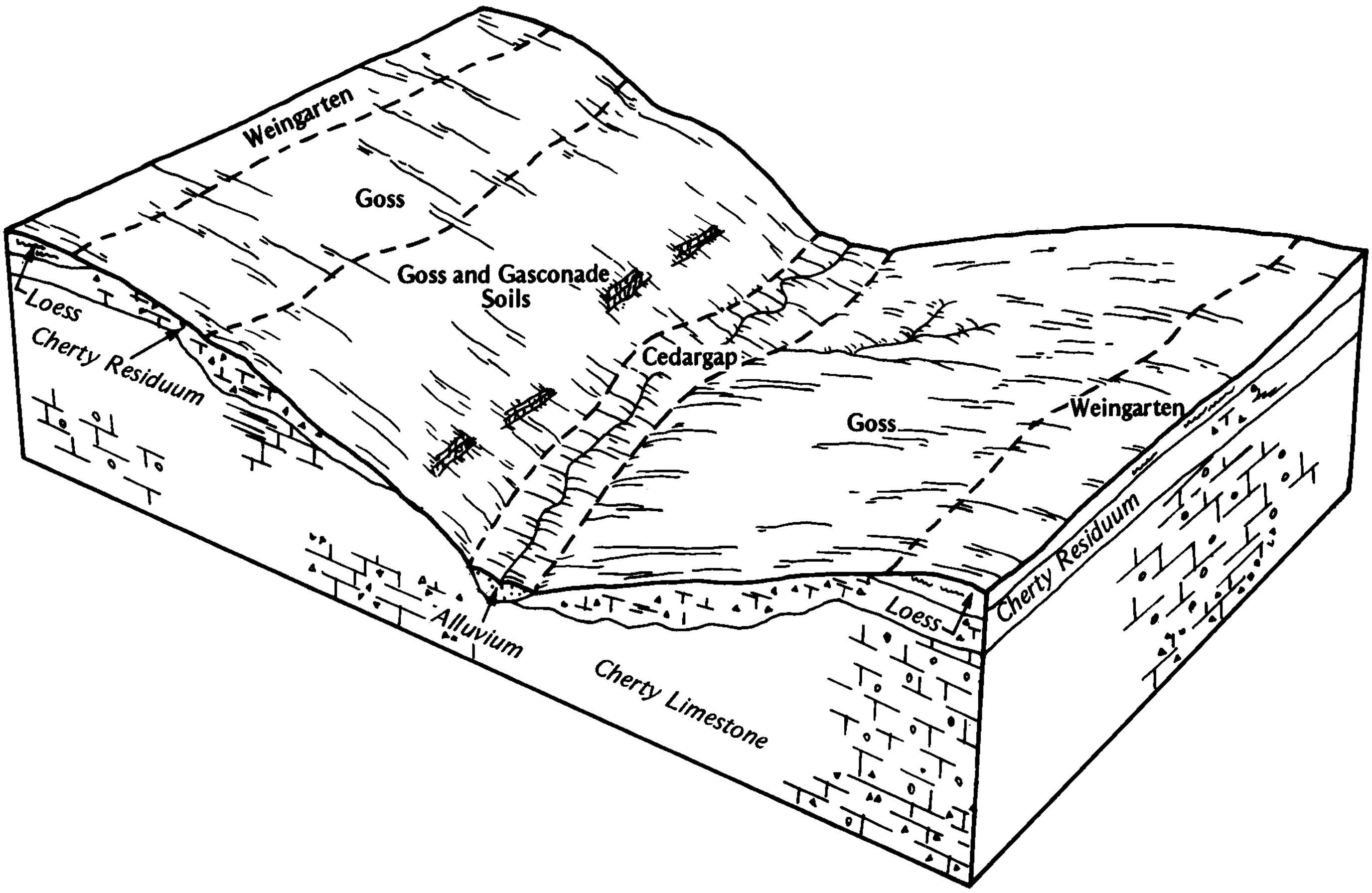

Figure 4.—Typical pattern of soils and parent material in the Goss-Gasconade association.

elevation of 200 feet or more within one-fourth mile are common. Valleys are deep and narrow and generally no more than one-fourth mile wide. Ridgetops are winding and narrow. On the lower side slopes and vertical limestone bluffs, many limestone outcrops overhang the flood plains along the Missouri River and its major tributaries.

This association makes up about 25 percent of the county. It is about 42 percent Goss soils, 26 percent Gasconade soils, and 32 percent minor soils (fig. 4).

Goss soils are mapped in a complex with Gasconade soils and rock outcrop. They are deep, strongly sloping to very steep, and well drained. They formed in cherty limestone residuum on convex side slopes, on strongly sloping, narrow ridge crests, and on the ends of ridges. Typically, the surface layer is very dark grayish brown and very dark gray cherty silt loam. The subsurface layer is light yellowish brown very cherty silt loam. The upper part of the subsoil is reddish brown and yellowish red very cherty silty clay loam; the next part is yellowish red and reddish brown, mottled very cherty silty clay; and the lower part is brown, mottled very cherty silty clay.

Gasconade soils are mapped in a complex with Goss soils and rock outcrop. They are shallow, moderately sloping to very steep, and somewhat excessively drained. They are on the side slopes of valleys in the dissected uplands, on narrow ridge crests, and on the ends of ridges. Typically, the surface layer is very dark brown flaggy silty clay loam. The subsoil is dark brown very flaggy silty clay. Fractured, hard limestone bedrock is at a depth of about 17 inches.

Minor in this association are the nearly level, loamy Cedargap soils on flood plains along small streams; the nearly level, silty Haymond and nearly level, loamy Landes soils on flood plains along the major tributaries; and the silty Weingarten soils on ridgetops.

About 70 percent of this association remains forested with native hardwoods, dominantly oak and hickory. The cleared areas consist mainly of minor soils on ridgetops, foot slopes, and flood plains. They are used for cultivated crops, hay, or pasture.

The forested part of this association is in areas that are too steep or too cherty to be cleared and farmed. Stand improvement is needed if the best timber production is to be obtained. Because of the steep slope, the use of logging equipment is restricted and erosion is a hazard along logging roads and skid trails.

Some of the less sloping minor soils are cleared and are suited to pasture and hay. The slope is a limitation, and erosion is a hazard. Droughtiness restricts the growth of all crops.

The major soils generally are not used for sanitary facilities and building site development. The slope, the depth to bedrock, and the content of chert are the main limitations.

The major soils are suited to habitat for openland and woodland wildlife. Recent residential development, however, has taken place on land suitable for wildlife habitat, especially for woodland wildlife habitat. Providing food for wildlife is a major management concern.

4. Winfield-Weller Association

Deep, gently sloping to steep, moderately well drained soils formed in loess; on uplands

This association consists of soils on the generally steep and deeply dissected uplands adjacent to the flood plains along the Missouri River.

This association makes up about 10 percent of the county. It is about 66 percent Winfield and similar soils, 22 percent Weller soils, and 12 percent minor soils (fig. 5).

Winfield soils are gently sloping to steep. They are on convex ridgetops and dissected side slopes below Weller soils. Typically, the surface layer is dark brown silt loam. The subsoil is brown silty clay loam in the upper part; brown, strong brown, dark brown, and dark yellowish brown, mottled silty clay loam in the next part; and dark brown, mottled silt loam in the lower part.

Weller soils are gently sloping to strongly sloping. They are mainly on the upper side slopes and on ridgetops and are more distant from the Missouri River than Winfield soils. Typically, the surface layer is

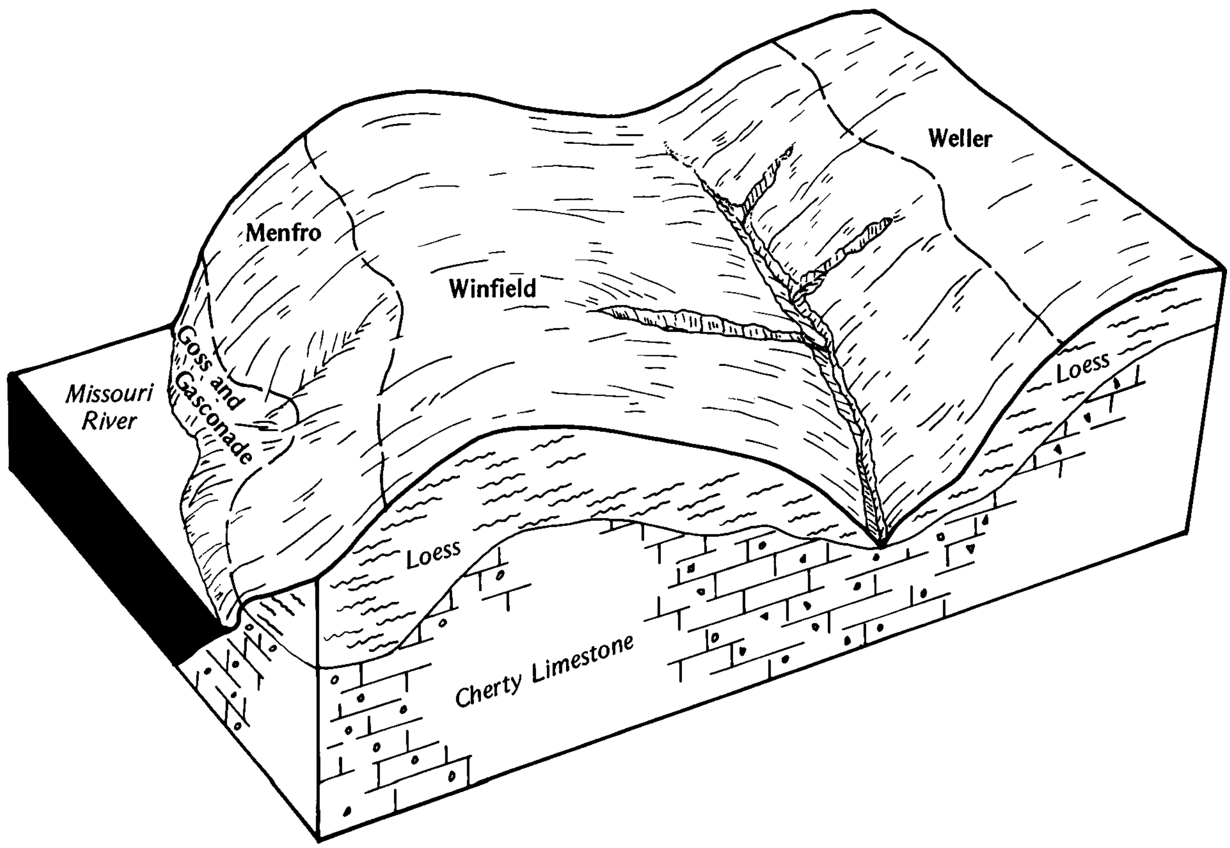

Figure 5.—Typical pattern of soils and parent material in the Winfield-Weller association.

grayish brown silt loam. The subsurface layer is brown silt loam. The subsoil is yellowish brown, mottled silt loam, silty clay loam, and silty clay in the upper part and light brownish gray and grayish brown, mottled silty clay loam in the lower part. The substratum is light brownish gray, mottled silt loam.

Minor in this association are Cedargap, Gasconade, Goss, Haymond, Menfro, and Wiota soils. The well drained Cedargap and Haymond soils are on flood plains. The shallow Gasconade soils are on steep side slopes that have limestone bedrock exposures and on vertical limestone escarpments on the bluffs facing the flood plains along the Missouri River. The cherty Goss soils are on steep side slopes. Menfro soils are similar to Goss soils. They are on the lower side slopes adjacent to the flood plains along the Missouri River. The well drained Wiota soils are on terraces at the base of many of the steep side slopes.

About 75 percent of this association remains forested with native hardwoods, dominantly oak and hickory. The cleared areas are mainly on ridgetops, foot slopes, and stream bottoms. They are used for cultivated crops, hay, or pasture.

The forested part of this association is in areas too steep to be cleared and cultivated. Stand improvement is needed if the best timber production is to be maintained. Because of the steep slope, the use of logging equipment is restricted and erosion is a hazard along logging roads and skid trails.

Controlling water erosion and gullying and improving or maintaining fertility and tilth are the main management concerns in the areas used for crops. In many areas slopes are long enough and smooth enough for terracing and farming on the contour. The erosion caused by overgrazing is the major management concern in the pastured areas. In areas that do not have flowing water, ponds provide water for livestock.

The major soils are suited to sanitary facilities and building site development. The main limitations are a moderate or high shrink-swell potential in the subsoil, the wetness, and the slope.

5. Grable-Waldron-Leta Association

Deep, nearly level, well drained and somewhat poorly drained soils formed in silty, loamy, and clayey alluvium; on the flood plains along the Missouri River

Differences among the soils in this association are largely the result of variations in the texture of the material in which they formed. The silty soils generally are in the highest positions on the landscape, and the clayey soils are in the lowest positions. Differences in elevation are slight.

This association makes up about 5 percent of the county. It is about 26 percent Grable soils, 23 percent Waldron soils, 18 percent Leta soils, and 33 percent minor soils (fig. 6).

Grable soils are well drained. They are mainly on natural levees and in areas of crevasse splay deposits. Typically, the surface layer is very dark grayish brown very fine sandy loam. The substratum is brown, mottled very fine sandy loam in the upper part; brown fine sand in the next part; and stratified brown and dark grayish brown, mottled loamy fine sand to silt loam in the lower part.

Waldron soils are somewhat poorly drained. They are in backswamps and in areas of abandoned channel fill. Typically, the surface layer is very dark gray silty clay. The substratum is dark grayish brown and grayish brown, mottled silty clay in the upper part; dark gray, mottled silty clay loam in the next part; and stratified brown and dark gray very fine sandy loam and silt loam in the lower part.

Leta soils are somewhat poorly drained. They are in areas of point bar deposits where moderately fine textured alluvium overlies medium textured alluvium. Typically, the surface layer and subsurface layer are very dark grayish brown silty clay loam. The subsoil is very dark grayish brown and dark grayish brown, mottled silty clay loam. The substratum is dark grayish brown, mottled very fine sandy loam in the upper part; grayish brown, mottled, stratified very fine sandy loam and silt loam in the next part; and grayish brown fine sand in the lower part.

Minor in this association are Belknap, Booker, Dupo, and Hodge soils. The silty Belknap soils are on alluvial fans. The very poorly drained, clayey Booker soils are in low slack-water areas. The silty Dupo soils are on alluvial fans and in areas of outwash where reworked loess overlies deposits of silty clay loam. The somewhat excessively drained Hodge soils are in the higher areas, mainly adjacent to the channel of the Missouri River.

This association is intensively cultivated. Corn, soybeans, and wheat are the main crops. A small acreage remains wooded, mainly in areas next to the channel of the Missouri River that are not protected from flooding.

The major soils are suited to row crops, small grain, and grasses and legumes. They are well suited to irrigation, which increases yields. Wetness is the main management concern in areas of Leta and Waldron soils.

The major soils are suited to trees. Most areas that are too wet or too frequently flooded to be used for crops remain wooded. Cottonwood is the dominant species. Pecan trees grow well on these soils. Wetness is the main limitation affecting planting and harvesting.

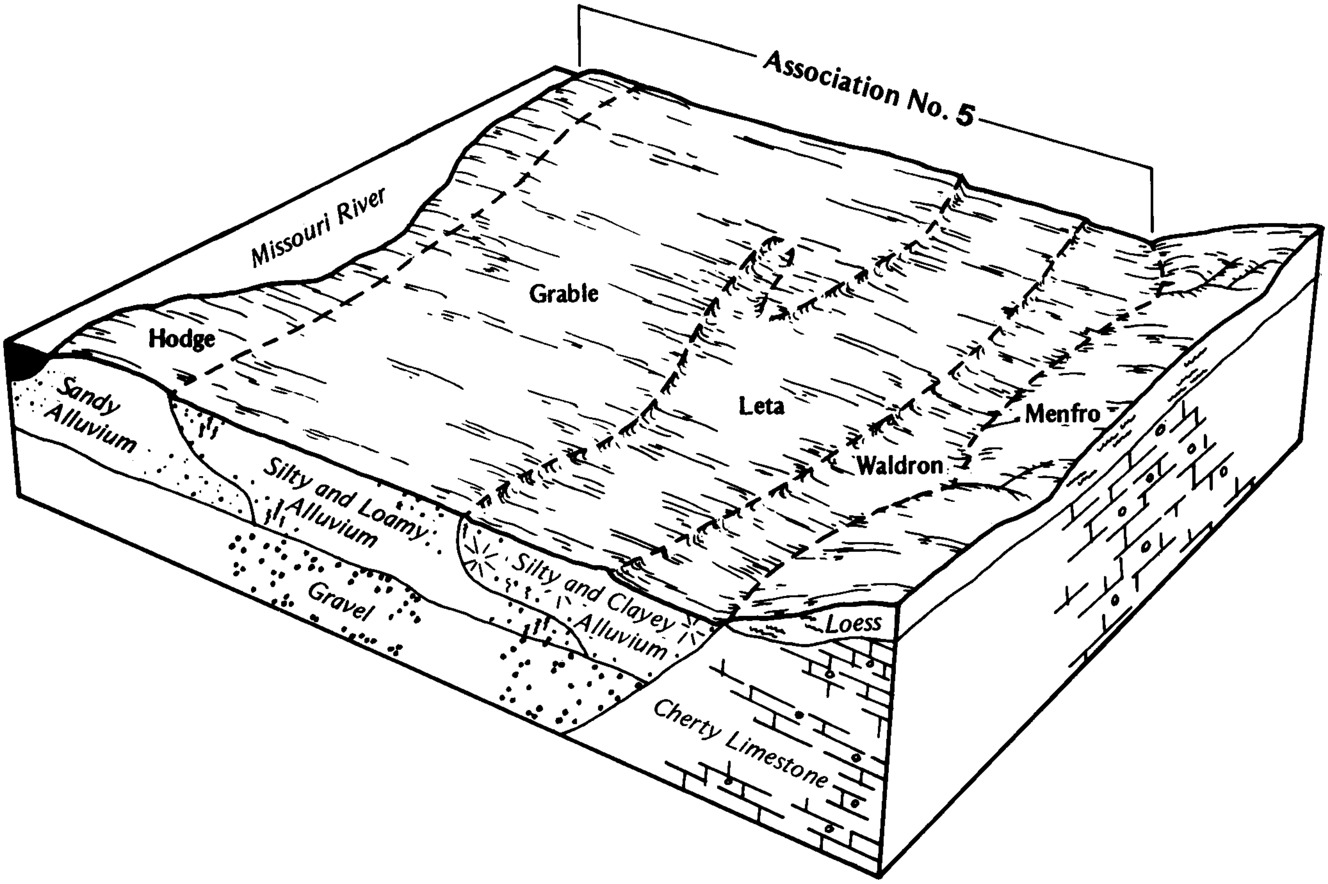

Figure 6.—Typical pattern of soils and parent material in the Grable-Waldron-Leta association.

The major soils generally are unsuitable for sanitary facilities and building site development because of the wetness and the hazard of flooding.

6. Lindley-Hatton Association

Deep, gently sloping to steep, well drained and moderately well drained soils formed in glacial till or in loess and pedisediments; on uplands

This association consists of soils on steep, highly dissected or narrow, rounded ridges and along the drainageways that separate them.

This association makes up about 4 percent of the county. It is about 65 percent Lindley soils, 25 percent Hatton soils, and 10 percent minor soils.

Lindley soils are strongly sloping to steep and are well drained. They are on side slopes below Hatton soils. Typically, the surface layer is very dark gray loam or clay loam. The subsurface layer is brown, mottled loam. The subsoil is strong brown clay loam in the upper part and yellowish brown and strong brown, mottled clay loam in the lower part. The substratum is strong brown, mottled clay loam.

Hatton soils are gently sloping and moderately sloping and are moderately well drained. They are on narrow, rounded ridgetops and the upper side slopes. Typically, the surface layer is very dark grayish brown silt loam. The subsurface layer is brown silt loam. In sequence downward, the subsoil is strong brown silty clay loam; dark brown and brown, mottled silty clay and silty clay loam; grayish brown and light brownish gray, mottled, brittle silt loam; and brown, mottled silty clay loam.

Minor in this association are Gasconade, Goss, Landes, and Marion soils. The shallow Gasconade soils are on the lower side slopes that have some limestone bedrock exposures. The cherty Goss soils are on side slopes between areas of Gasconade and Hatton soils. The loamy Landes soils are on bottom land. The somewhat poorly drained Marion soils are on nearly level ridgetops.

About 15 percent of this association has been cleared. Most of the cleared areas are on ridgetops and are used as pasture. The erosion caused by overgrazing is the major concern in managing the pastured areas. Ponds provide water for livestock.

This association is suitable for trees. Most areas remain forested with stands of good-quality white oak.

The major soils on ridgetops are suited to building site development. The wetness, a moderate shrink-swell potential, and restricted permeability are the main limitations. Many buildings have been constructed around several large lakes in areas of this association.

7. Armster, Cobbly, Association

Deep, moderately sloping to steep, moderately well drained soils formed in loess or pedisediments and in glacial till; on uplands

This association consists of soils on long, narrow ridgetops and hillsides. It makes up about 2 percent of the county. It is 55 percent Armster soils and 45 percent minor soils.

Armster soils are moderately sloping to steep. Typically, the surface layer is black cobbly loam. The subsoil is mixed brown and red, mottled clay loam in the upper part; dark yellowish brown and yellowish brown, mottled clay loam in the next part; and mottled light gray, brownish yellow, and yellowish brown clay loam in the lower part. The substratum is mottled light gray and yellowish brown clay loam.

Minor in this association are Cedargap, Gorin, Keswick, and Lindley soils. The well drained Cedargap soils are on narrow flood plains. The somewhat poorly drained Gorin soils are on the slightly broader ridgetops. They are browner than the Armster soils. Keswick soils have a light colored, noncobbly surface layer. They are in landscape positions similar to those of the Armster soils. The well drained Lindley soils are on side slopes below the Armster soils. They have a light colored surface layer and contain less clay than the Armster soils.

About 60 percent of this association has been cleared. Most of the cleared areas on hillsides are used as pasture. Livestock production is a major enterprise. Very few areas are used for row crops. The uneven, moderately steep and steep areas generally support mixed hardwoods.

Controlling water erosion and improving or maintaining fertility and tilth are the main management concerns in the areas used for crops. Because the soils are high in content of chert and limestone fragments, tillage is hazardous and difficult.

The erosion caused by overgrazing is the major concern in managing the pastured areas. In areas that do not have flowing water, ponds provide water for livestock.

The Armster soils are suited to trees. Most wooded areas are too steep or too uneven to be cleared. The dominant species are oak and hickory.

The Armster soils are suitable for building site development. A high shrink-swell potential in the clayey subsoil and the stones are severe limitations on building sites. Because of slow permeability, these soils are poorly suited to septic tank absorption fields. They generally are better suited to sewage lagoons.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can help to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Weller silt loam, 2 to 5 percent slopes, is a phase of the Weller series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Goss-Gasconade-Rock outcrop complex, 5 to 35 percent slopes, is an example.

Most map units include scattered small areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

The descriptions, names, and delineations of the soils identified on the detailed soil maps in this survey do not fully agree or join with those of the soils identified on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local variations. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping these soils separately.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

Soil Descriptions

9C2—Armster loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on convex side slopes and narrow ridgetops in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 20 to 400 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 6 inches thick. The subsoil extends to a depth of about 69 inches or more. The upper part is dark brown and dark yellowish brown, mottled, firm clay loam; the next part is dark brown, yellowish brown, and strong brown, mottled, firm clay; and the lower part is light brownish gray, mottled, very firm clay. In some eroded areas the surface layer has been mixed with subsoil material and is grayish brown loam.

Included with this soil in mapping are small areas of the moderately deep Snead soils. These soils have more clay and less sand than the Armster soil. They are on the lower side slopes. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is medium in cultivated areas. The available water capacity is moderate. A perched water table is at a depth of 3 to 5 feet during most winter and spring months. Natural fertility is medium, and the organic matter content is moderately low. The shrink-swell potential is high. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after hard rains, especially in plowed areas where it contains subsoil material.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, small grain, and grain sorghum. If cultivated crops are grown, further erosion is a severe hazard. A combination of terraces and grassed waterways or tile outlets, a system of conservation tillage that leaves a protective cover of crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Special management may be needed in areas where terracing has exposed the clayey subsoil. In these areas, tilling the soil is difficult and fertility and the available water capacity are low. These limitations can be minimized by stockpiling the topsoil from the area where the terrace is to be constructed and redistributing it over the exposed clayey area. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent surface crusting.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; cool-season grasses, such as smooth brome and orchardgrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suitable for building site development if proper design and installation procedures are used. The basement walls, foundations, and footings of small commercial buildings and dwellings should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by the shrinking and swelling of the subsoil. The slope is a limitation on sites for small commercial buildings. The site can be leveled during construction. Installing drainage tile around the footings and foundations helps to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled and the berms and bottom of the lagoon are sealed with slowly permeable material, which helps to prevent the contamination of ground water. Also, sewage generally can be piped to the adjacent areas that are suitable for sewage lagoons.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

9D2—Armster loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on convex side slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 25 to 115 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. The subsoil is about 40 inches thick. In sequence downward, it is reddish brown and yellowish red, mottled, firm clay loam; strong brown, mottled, firm clay and clay loam; light brownish gray, mottled, firm clay loam; and mixed yellowish brown and light brownish gray, mottled, firm clay loam. The substratum to a depth of 83 inches is yellowish brown, friable clay loam. In some severely eroded areas, shallow gullies and deep rills have formed and the soil does not have a dark surface layer.

Included with this soil in mapping are small areas of the moderately deep Snead soils. These soils have more clay and less sand than the Armster soil. They are on the lower side slopes. Also included are some severely eroded areas where the surface layer is brown clay. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is rapid in cultivated areas. The available water capacity is moderate. A perched water table is at a depth of 3 to 5 feet during most winter and spring months. Natural fertility is medium, and the organic matter content is moderately low. The shrink-swell potential is high. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after hard rains, especially in plowed areas where it contains subsoil material.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to cultivated crops only if the crops are grown on a limited basis in rotation with close-grown pasture and hay crops. If cultivated crops are grown, further erosion is a severe hazard. A combination of terraces and grassed waterways or tile outlets, a system of conservation tillage that leaves a protective cover of crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Special management may be needed in areas where terracing has exposed the clayey subsoil. In these areas, tilling the soil is difficult and fertility and the available water capacity are low. These limitations can be minimized by stockpiling the topsoil from the area where the terrace is to be constructed and redistributing it over the exposed clayey area. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management concerns. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suitable for building site development if proper design and installation procedures are used. The basement walls, foundations, and footings of small commercial buildings and dwellings should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by the shrinking and swelling of the subsoil. The slope is a limitation on sites for small commercial buildings. The site can be leveled during construction. Installing drainage tile around the footings and foundations helps to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability. Properly constructed sewage lagoons can function adequately if the site is leveled.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, frost action, and the wetness are the main limitations. Some cutting and filling may be necessary because of the slope. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IVe. The woodland ordination symbol is 4A.

10C2—Armstrong loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, somewhat poorly drained soil is on convex side slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 6 inches thick. The subsoil extends to a depth of 66 inches or more. The upper part is dark yellowish brown, friable clay loam; the next part is reddish brown, mottled, firm clay and multicolored, firm clay; and the lower part is yellowish brown, light brownish gray, and dark yellowish brown, mottled, firm clay loam. In some areas, the upper part of the subsoil has been plowed into the surface soil and the surface layer is dark grayish brown loam. In some places the lower part of the subsoil is gray, very firm clay. In other places the soil has a dark surface layer more than 10 inches thick.

Permeability is slow. Surface runoff is medium in cultivated areas. The available water capacity is

Figure 7.—Horses grazing tall fescue in an area of Armstrong loam, 5 to 9 percent slopes, eroded.

moderate. Natural fertility is medium, and the content of organic matter is moderate. The shrink-swell potential is high in the subsoil. The surface layer is friable, but it can be easily tilled only within a fairly narrow range in moisture content. A perched water table is at a depth of 1 to 3 feet during most winter and spring months.

Most areas are used for row crops, hay, or pasture (fig. 7). Some areas are used as woodland. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a severe hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface, stripcropping, winter cover crops, and a combination of terraces and grassed waterways or tile outlets help to prevent excessive soil loss. Special management may be needed in areas where terracing has exposed the clayey subsoil. In these areas, tilling the soil is difficult and fertility and the available water capacity are low. These limitations can be minimized by stockpiling the topsoil from the area where the terrace is to be constructed and redistributing it over the exposed clayey area. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

A few small areas support native hardwoods. This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development if proper design and installation procedures are used. The basement walls, foundations, and footings of small commercial buildings and dwellings should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by the shrinking and swelling of the subsoil. The slope is a limitation on sites for small commercial buildings. The site can be leveled during construction. Installing drainage tile around the footings and foundations helps to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability. Sewage lagoons can function adequately, but the slope is a limitation. The site generally can be leveled during construction.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

10D2—Armstrong loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, somewhat poorly drained soil is on convex side slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregularly shaped and range from about 10 to 60 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is about 31 inches thick. The upper part is dark brown, firm clay loam; the next part is dark yellowish brown, mottled, firm clay loam; and the lower part is yellowish brown, mottled, firm clay. The substratum to a depth of 60 inches or more is mottled yellowish brown, gray, and light yellowish brown, firm clay loam. In some areas nearly all of the original surface layer has been removed by erosion. In other areas the lower part of the subsoil is gray, very firm clay.

Permeability is slow. Surface runoff is rapid in cultivated areas. The available water capacity is moderate. Natural fertility is low, and the content of organic matter is moderate. The shrink-swell potential is high in the subsoil. The surface layer is friable, but it can be easily tilled only within a fairly narrow range in moisture content. A perched water table is at a depth of 1 to 3 feet during most winter and spring months.

Most areas are used for hay or pasture. Some areas are used as woodland. This soil is suited to cultivated crops, but row crops and small grain can be grown only on a limited basis in rotation with close-growing pasture and hay crops. If cultivated crops are grown, erosion is a severe hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface, stripcropping, winter cover crops, and a combination of terraces and grassed waterways or tile outlets help to prevent excessive soil loss. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Special management is needed in some areas where terracing has exposed the clayey subsoil. In these areas, the soil cannot be easily tilled and fertility and the available water capacity are low. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is moderately well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. Erosion is the main problem. A good ground cover is necessary at all times if production is to be maintained. Nurse crops help to prevent excessive soil loss in newly seeded areas. Timely tillage is needed. Also, the soil should be tilled on the contour. No-till seeding methods help to protect the surface. Overgrazing should be avoided.

A few small areas support native hardwoods. This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development if proper design and installation procedures are used. The basement walls, foundations, and footings of dwellings should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by the shrinking and swelling of the subsoil. The dwellings can be designed so that they conform to the natural slope of the land. Also, the slope can be altered by land shaping. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability. Sewage lagoons can function adequately, but the slope is a limitation. Sites for the lagoons generally can be leveled, or sewage can be piped to areas of less sloping soils that are better suited to lagoons.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, frost action, and the wetness are the main limitations. Some cutting and filling may be necessary because of the slope. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IVe. The woodland ordination symbol is 3C.

13A—Auxvasse silt loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to 35 acres in size.

Typically, the surface layer is dark brown, very friable silt loam about 9 inches thick. The subsurface layer is pale brown, friable silt loam about 9 inches thick. The next 3 inches is yellowish brown, mottled, friable silty clay that has coatings of light brownish gray silt. The subsoil is grayish brown, mottled, firm silty clay about 10 inches thick. The substratum to a depth of 60 inches or more is grayish brown, mottled, very firm silty clay loam. In some areas along the sides of the terraces, slopes are short and steep.

Included with this soil in mapping are small areas of Moniteau soils. These soils have less clay than the Auxvasse soil. They are in landscape positions similar to those of the Auxvasse soil. They make up 2 to 5 percent of the unit.

Permeability is very slow in the Auxvasse soil. Surface runoff is slow in cultivated areas. The available water capacity is moderate. Natural fertility and the organic matter content are low. The shrink-swell potential is high. A perched water table is at a depth of 1 to 2 feet during most winter and spring months. The surface layer is friable and can be easily tilled. Root development is somewhat restricted by poor aeration below a depth of 21 inches.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and small grain. Wetness is a problem during most spring months. Some land grading and shallow surface ditches are needed. Insufficient soil moisture commonly affects row crops in summer. High plant populations of corn and grain sorghum should be avoided. Because the soil is quite acid and is low in fertility, applications of lime and fertilizer are needed. Returning crop residue to the soil or adding manure improves fertility and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Wetness in spring and winter is the main problem. Grazing during wet periods should be avoided.

Some areas support stands of native hardwoods. This soil is suited to trees. The equipment limitation, seedling mortality, and windthrow are management concerns. Equipment should be used only during periods when the topsoil is dry and firm or during periods in winter when the ground is frozen. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil generally is not used for building site development or onsite waste disposal because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

15B—Calwoods silt loam, 2 to 5 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on convex ridgetops in the uplands. Individual areas are generally elongated and range from about 10 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is dark grayish brown and brown, friable silt loam about 5 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is brown, friable silty clay loam; the next part is dark grayish brown and grayish brown, mottled, firm silty clay; and the lower part is dark grayish brown and gray, mottled, firm silty clay loam. In places, the subsoil has been plowed into the surface soil and the surface layer is grayish brown silty clay loam. Some areas are nearly level.

Included with this soil in mapping are small areas of the somewhat poorly drained Gorin and Marion soils. Gorin soils are browner in the upper part of the subsoil than the Calwoods soil. They are on the narrower, more rounded ridgetops. Marion soils are characterized by an abrupt textural change. They are in the slightly higher nearly level areas. Included soils make up 2 to 10 percent of the unit.

Permeability is very slow in the Calwoods soil. Surface runoff is medium in cultivated areas. The

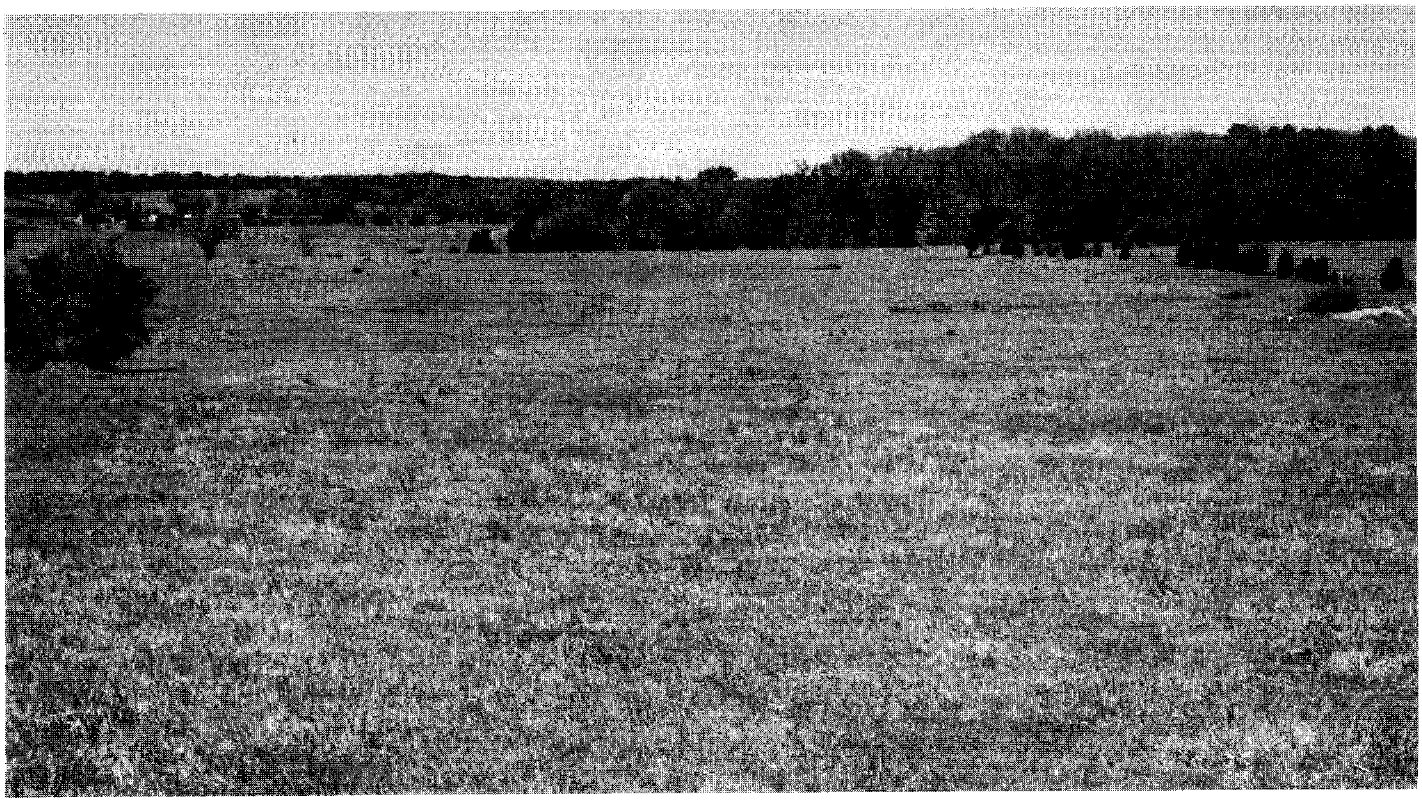

Figure 8.—Tall fescue pasture in an area of Calwoods silt loam, 2 to 5 percent slopes.

available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is high. A perched water table is at a depth of 1.0 to 2.5 feet during most winter and spring months. The surface layer is friable, but it can be easily tilled only within a fairly narrow range in moisture content and tends to crust or puddle after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, accelerated erosion is a moderate hazard. The measures commonly used to control erosion are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, a combination of terraces and grassed waterways or tile outlets, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops (fig. 8). Some type of grade stabilization structure generally is needed in conjunction with grassed waterways.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suited to building site development. The high shrink-swell potential and the wetness are limitations. The footings, foundations, and basement walls of small commercial buildings and dwellings should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations can minimize the damage caused by excessive wetness. Some land shaping generally is necessary on sites for small commercial buildings because of the slope. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly designed sewage lagoons can function adequately.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIe. The woodland ordination symbol is 3C.

15B2—Calwoods silt loam, 2 to 5 percent slopes, eroded. This deep, gently sloping, somewhat poorly drained soil is on convex ridgetops in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are generally elongated and range from about 10 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 34 inches thick. The upper part is dark yellowish brown, mottled, firm silty clay loam; the next part is grayish brown, mottled, firm silty clay and silty clay loam; and the lower part is dark grayish brown, mottled, firm silty clay loam. The substratum to a depth of 68 inches or more is grayish brown, mottled, firm clay loam. In some areas, the upper part of the subsoil has been plowed into the surface soil and the surface layer is grayish brown silty clay loam. In some severely eroded areas, the surface layer is grayish brown silty clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Gorin and Marion soils. Gorin soils have a light colored surface layer. They are on the narrower, more rounded ridgetops. Marion soils are characterized by an abrupt textural change. They are in the slightly higher nearly level areas. Included soils make up 2 to 10 percent of the unit.

Permeability is very slow in the Calwoods soil. Surface runoff is medium in cultivated areas. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is high. A perched water table is at a depth of 1.0 to 2.5 feet during winter and spring. The surface layer is friable, but it can be easily tilled only within a fairly narrow range in moisture content and tends to crust or puddle after hard rains, especially in areas where the plow layer contains subsoil material.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, accelerated erosion is a moderate hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, a combination of terraces and grassed waterways or tile outlets, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Special management may be needed in areas where terracing has exposed the clayey subsoil. In these areas, tilling the soil is difficult and fertility and the available water capacity are low. These limitations can be minimized by stockpiling the topsoil from the area where the terrace is to be constructed and redistributing it over the exposed clayey area. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suited to building site development. The high shrink-swell potential and the wetness are limitations. The footings, foundations, and basement walls of small commercial buildings and dwellings should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations can minimize the damage caused by excessive wetness. Some land shaping generally is necessary on sites for small commercial buildings because of the slope. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly designed sewage lagoons can function adequately.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

16C2—Crider silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, well drained soil is on side slopes in the uplands bordering small streams and drainageways. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are long and narrow and are parallel to streams. They commonly range from 10 to 40 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 8 inches thick. The subsoil extends to a depth of about 70 inches or more. The upper part is dark brown, friable silt loam. The next part is dark brown and reddish brown, firm silty clay loam. The lower part is red, firm silty clay loam. In some areas the surface layer has been mixed with the subsoil by plowing and is brown silty clay loam.

Included with this soil in mapping are some areas of the well drained, cherty Goss soils. These soils are steeper than the Crider soil. They are on side slopes above the Crider soil. They make up about 2 to 10 percent of the unit.

Permeability is moderate in the Crider soil. Surface runoff is medium in cultivated areas. The available water capacity is high. Natural fertility is low, and the organic matter content is moderate. The surface layer is friable and can be easily tilled, but it tends to crust after hard rains because it has been mixed with some of the subsoil.

Most areas are used as pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, a combination of terraces and grassed waterways or tile outlets, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Special management may be needed in areas where terracing has exposed the clayey subsoil. In these areas, tilling the soil is difficult and fertility and the available water capacity are low. These limitations can be minimized by stockpiling the topsoil from the area where the terrace is to be constructed and redistributing it over the exposed clayey area. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; cool-season grasses, such as smooth brome and orchardgrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

A few areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suitable for building site development if proper design and installation procedures are used. Enlarging the distribution lines helps to ensure that septic tank absorption fields function adequately. Excessive seepage from lagoons, ponds, and lakes can be minimized by special treatment to seal the reservoir area.

This soil is suited to local roads and streets. Low strength is a limitation. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts can improve drainage.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

16D2—Crider silt loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, well drained soil is on side slopes in the uplands bordering small streams and drainageways. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are commonly narrow and elongated and range from 10 to 40 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 7 inches thick. The subsoil extends to a depth of about 60 inches or more. The upper part is brown and reddish brown, firm silt loam and silty clay loam. The lower part is dark red and red, firm silty clay loam. In some severely eroded areas, the surface layer is reddish brown, firm silty clay loam.

Included with this soil in mapping are small areas of the steep, cherty Goss soils. These soils are on side slopes above the Crider soil. They make up 5 to 10 percent of the unit.

Permeability is moderate in the Crider soil. Surface runoff is rapid in cultivated areas. The available water capacity is high. Natural fertility is low, and the organic matter content is moderate. The surface layer is friable and can be easily tilled, but it tends to crust after hard rains because it has been mixed with some of the subsoil.

Most areas are used as pasture or woodland. This soil is suited to occasional cultivation. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management concerns. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Some areas support native hardwoods, dominantly oak. This soil is suited to trees. No major limitations or hazards affect planting or harvesting.

This soil is suitable for building site development if proper design and installation procedures are used. The dwellings should be designed so that they conform to the natural slope of the land. Enlarging the distribution lines and installing them across the slope help to ensure that septic tank absorption fields function adequately. Land shaping is necessary in some areas.

This soil is suited to local roads and streets. The slope and low strength are limitations. Some cutting and filling may be necessary because of the slope. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts can improve drainage.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

18F—Goss-Gasconade-Rock outcrop complex, 5 to 35 percent slopes. This map unit occurs as areas of a deep, moderately steep to very steep, well drained Goss soil; a shallow, moderately sloping to very steep, somewhat excessively drained Gasconade soil; and Rock outcrop. The Goss soil is on the upper side slopes in the uplands. The Gasconade soil and Rock outcrop generally are intermingled on short, steep upland slopes below the Goss soil (fig. 9). Slopes are long, and drainageways are deeply incised into the landscape. This unit is about 60 percent Goss soil, 20 percent Gasconade soil, and 15 percent Rock outcrop. The two soils and the Rock outcrop occur as areas so closely intermingled that they could not be shown separately at the scale selected for mapping. Individual areas range from 10 to more than 100 acres in size.

Typically, the surface layer of the Goss soil is very dark grayish brown and very dark gray, friable cherty silt loam about 3 inches thick. The subsurface layer is light yellowish brown, friable very cherty silt loam about 8 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is reddish brown and yellowish red, firm very cherty silty clay loam; the next part is yellowish red and reddish brown, mottled, firm very cherty silty clay; and the lower part is brown, mottled, firm very cherty silty clay. In places the soil has a thinner subsoil and is shallower to limestone bedrock.

Typically, the surface layer of the Gasconade soil is very dark brown, firm flaggy silty clay loam about 9 inches thick. The subsoil is dark brown, firm very flaggy silty clay about 8 inches thick. Fractured, hard limestone bedrock is at a depth of about 17 inches. In places the depth to bedrock is more than 20 inches.

The Rock outcrop is limestone bedrock on side slopes, where it ranges from a few to several hundred square feet in size, and on vertical bluffs that rise as much as 100 feet or more above the flood plains along the Missouri River and its major tributaries.

Included in this unit in mapping are small areas of the deep, chert-free Crider, Menfro, and Winfield soils. Crider soils are at the base of some slopes. Menfro and Winfield soils are on uplands near the flood plains along the Missouri River. Also included are some areas of soils that are shallow over sandstone bedrock, thinly bedded shale, or coal. Included soils make up less than 5 percent of the unit.

Permeability is moderate in the Goss soil and moderately slow in the Gasconade soil. Surface runoff is rapid on both soils. The available water capacity is low in the Goss soil and very low in the Gasconade soil. Natural fertility is low in the Goss soil and medium in the Gasconade soil. The organic matter content is moderately low in the Goss soil and moderate in the Gasconade soil.

Most areas support native timber. Some areas support native hardwoods. The Goss and Gasconade soils are suited to trees. The hazard of erosion, the equipment limitation, seedling mortality, and windthrow are management concerns. Care is needed in designing and constructing logging roads and skid trails. Logs can

Figure 9.—A typical area of Goss-Gasconade-Rock outcrop complex, 5 to 35 percent slopes.

be yarded uphill to the logging roads and skid trails. Properly managing the ground cover and seeding disturbed areas help to control erosion. The seedling survival rate can be increased by selecting container-grown nursery stock for planting in areas where reinforcement planting is needed. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

If properly managed, the Goss and Gasconade soils are suitable for many recreational uses, including camp and picnic areas and nature trails. They are in areas that have a natural esthetic value.

The Goss and Gasconade soils generally are not used for building site development or onsite waste disposal because of the slope and the shallowness to bedrock. They are suitable for low-density building site development if site preparation is extensive, but the cost of such preparation can be prohibitive.

The land capability classification is VIIe. The woodland ordination symbol is 3R in areas of the Goss soil and 2R in areas of the Gasconade soil.

19C—Gorin silt loam, 3 to 9 percent slopes. This deep, gently sloping and moderately sloping, somewhat poorly drained soil is on narrow ridgetops and the upper side slopes in the uplands. Individual areas are irregular in shape and range from 15 to several hundred acres in size.

Typically, the surface layer is very dark gray, very friable silt loam about 3 inches thick. The subsurface layer is brown, friable silt loam about 5 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is brown, mottled, friable and firm silty clay loam; the next part is brown, mottled, firm silty clay; and the lower part is grayish brown and brown, mottled, firm silty clay loam. In some places the lower part of the subsoil is grayer, and in other places it has less sand.

Included with this soil in mapping are small areas of Calwoods, Keswick, and Marion soils. Calwoods soils are on the broader ridges. They are grayer in the subsoil than the Gorin soil. The moderately well drained Keswick soils are on the lower side slopes. They have a higher content of glacial sand and pebbles than the Gorin soil. Marion soils are characterized by an abrupt textural change between the surface soil and the subsoil. They are on nearly level ridgetops. Included soils make up 2 to 10 percent of the unit.

Permeability is slow in the Gorin soil. Surface runoff is medium in cultivated areas. The available water capacity is high. Natural fertility and the organic matter content are low. The shrink-swell potential is high. A perched water table is at a depth of 2 to 4 feet during most winter and spring months. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used as woodland or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

Some areas support native hardwoods. This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suited to building site development if proper design and installation procedures are used. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations can help to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly designed sewage lagoons can function adequately. Some leveling is necessary because of the slope.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

19C2—Gorin silt loam, 3 to 9 percent slopes, eroded. This deep, gently sloping and moderately sloping, somewhat poorly drained soil is on narrow ridgetops in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 15 to several hundred acres in size.

Typically, the surface layer is brown, friable silt loam about 5 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is yellowish brown and strong brown, mottled, firm silty clay loam and silty clay, and the lower part is grayish brown, brown, and dark yellowish brown, mottled, firm silty clay and silty clay loam. In a few areas, erosion has removed most of the original surface soil and the remaining surface layer is brown or dark yellowish brown silty clay loam. In some places the lower part of the subsoil is gray clay, and in other places it has less sand.

Included with this soil in mapping are small areas of Calwoods, Keswick, and Marion soils. Calwoods soils are on the broader ridges. They are grayer in the subsoil than the Gorin soil. The moderately well drained Keswick soils are on side slopes below the Gorin soil. They have a higher content of glacial sand and pebbles than the Gorin soil. Marion soils are characterized by an abrupt textural change between the surface soil and the subsoil. They are on nearly level ridgetops. Included soils make up 2 to 10 percent of the unit.

Permeability is slow in the Gorin soil. Surface runoff is medium in cultivated areas. The available water capacity is high. Natural fertility and the organic matter content are low. The shrink-swell potential is high. A perched water table is at a depth of 2 to 4 feet during most winter and spring months. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, further erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

Some areas support native hardwoods. This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suited to building site development if proper design and installation procedures are used. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations can help to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly designed sewage lagoons can function adequately if the bottom and sides of the lagoons are sealed.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

20D—Goss cherty silt loam, 9 to 14 percent slopes. This deep, strongly sloping, well drained soil is on convex side slopes and the crest of ridges in the uplands. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark gray, friable cherty silt loam about 3 inches thick. The subsurface layer is pale brown and light yellowish brown, friable cherty silt loam about 5 inches thick. The subsoil is about 16 inches thick. The upper part is brown, firm very cherty silty clay loam, and the lower part is yellowish red or strong brown, mottled, firm very cherty silty clay. The substratum to a depth of 60 inches or more is light brownish gray, mottled, firm cherty silty clay loam. In places the soil has a thinner subsoil and is shallower to limestone bedrock.

Included with this soil in mapping are small areas of the shallow Gasconade soils and the deep Crider soils. Gasconade soils are on short, steep escarpments at the base of some side slopes. The chert-free Crider soils are at the base of other side slopes. Also included are small areas of the chert-free Menfro, Weller, and Winfield soils on the higher side slopes and some areas where the soil is shallow over sandstone or shale bedrock. Included soils make up 5 to 14 percent of the unit.

Permeability is moderate in the Goss soil. Surface runoff is rapid. The available water capacity is low. Natural fertility also is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. The surface layer cannot be easily tilled because of the high content of chert.

Most areas support native timber. Because of the slope, droughtiness, and the content of coarse fragments, this soil is unsuitable for cultivated crops and hay.

This soil is moderately suited to legumes, such as crownvetch and lespedeza; cool-season grasses, such as tall fescue; and warm-season grasses, such as Caucasian bluestem and indiangrass. Droughtiness, erosion, and the chert fragments in the surface layer are the main management concerns. Minimizing disturbance of the seedbed by tilling with a field cultivator helps to control erosion while a pasture stand is becoming established. Special equipment may be needed. The steeper slopes can be seeded and fertilized by aerial application without seedbed preparation. A well established grass stand adequately controls erosion if it is protected from overgrazing.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to low-density building site development if proper design and construction procedures are used. Dwellings can be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas. Large stones should be removed from the construction sites. Footings and foundations should be constructed with adequately reinforced concrete, which helps to prevent the structural damage caused by shrinking and swelling.

This soil is suitable as a site for septic tank absorption fields if proper design and installation procedures are used. The main limitations are the slope, the moderate permeability, and large stones. Land shaping generally is needed. The distribution lines should be installed across the slope. Enlarging the absorption field helps to overcome the restricted permeability.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, frost action, and the wetness are limitations. Some cutting and filling may be necessary because of the slope. Also, the roads can be designed so that they conform to the natural slope of the land. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water minimizes the damage caused by shrinking and swelling and by frost action.

The land capability classification is VIe. The woodland ordination symbol is 3A.

21C—Hatton silt loam, 3 to 9 percent slopes. This deep, gently sloping and moderately sloping, moderately well drained soil is on narrow, rounded ridgetops in the uplands. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is brown, friable silt loam about 5 inches thick. The subsoil extends to a depth of 70 inches or more. In sequence downward, it is strong brown, firm silty clay loam; dark brown and brown, mottled, firm silty clay and silty clay loam; grayish brown and light brownish gray, mottled, firm and brittle silt loam; and brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of Keswick and Lindley soils. These soils have a higher content of glacial sand and pebbles than the Hatton soil. They are on side slopes below the Hatton soil. Also included are intermingled areas of severely eroded Hatton soils. Included soils make up 2 to 10 percent of the unit.

Permeability is very slow in the Hatton soil. Surface runoff is medium in cultivated areas. The available water capacity is moderate. Natural fertility is low, and the organic matter content is moderately low. A perched water table is at a depth of 2 to 3 feet during most winter and spring months. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. It crusts or puddles, however, after hard rains, especially where the plow layer contains subsoil material. Root development is somewhat restricted by the compactness of the lower part of the subsoil.

Most areas support native hardwoods or are used for pasture or hay. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Insufficient soil moisture commonly affects row crops during the summer. High plant populations of corn and grain sorghum should be avoided. Under natural conditions, the soil is quite acid and is low in fertility. Applications of lime and fertilizer are needed. Returning crop residue to the soil and regularly adding barnyard manure improve fertility and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss. Overgrazing should be avoided.

Many areas support native hardwoods, dominantly good-quality white oak. This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suited to building site development if proper design and installation procedures are used. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations can help to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly designed sewage lagoons can function adequately. Some leveling is necessary because of the slope.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

21C2—Hatton silt loam, 3 to 9 percent slopes, eroded. This deep, gently sloping and moderately sloping, moderately well drained soil is on narrow, rounded ridgetops in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is yellowish brown, mottled, firm silty clay loam; the next part is yellowish brown, mottled, firm silty clay; and the lower part is grayish brown, mottled, firm and brittle silty clay loam. In places the upper part of the subsoil has grayish brown mottles. In some uneroded areas the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas of Keswick and Lindley soils. These soils have a higher content of glacial sand and pebbles than the Hatton soil. They are on side slopes below the Hatton soil. Also included are small areas of severely eroded Hatton soils. Included soils make up 2 to 10 percent of the unit.

Permeability is very slow in the Hatton soil. Surface runoff is medium in cultivated areas. The available water capacity is moderate. Natural fertility is low, and the organic matter content is moderately low. A perched water table is at a depth of 2 to 3 feet during most winter and spring months. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. It crusts or puddles, however, after hard rains, especially where the plow layer contains subsoil material. Root development is somewhat restricted by the compactness of the lower part of the subsoil.

Most areas are used for cultivated crops, pasture, or hay. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Insufficient soil moisture commonly affects row crops in summer. High plant populations of corn and grain sorghum should be avoided. Under natural conditions, the soil is quite acid and is low in fertility. Applications of lime and fertilizer are needed. Returning crop residue to the soil and regularly adding barnyard manure can improve fertility and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss. Overgrazing should be avoided.

Many areas support native hardwoods, dominantly good-quality white oak. This soil is suited to trees.

Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suited to building site development if proper design and installation procedures are used. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations can help to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil generally is unsuitable as a site for septic tank absorption fields because of the restricted permeability and the wetness. Properly designed sewage lagoons can function adequately. Some leveling is necessary because of the slope.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

22C2—Keswick loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is dark brown, friable loam about 6 inches thick. The subsoil is about 42 inches thick. The upper part is yellowish red, reddish brown, and grayish brown, mottled, firm clay, and the lower part is brown and dark yellowish brown, mottled, firm clay and clay loam. The substratum to a depth of 60 inches or more is mottled yellowish brown, strong brown, and light brownish gray, firm clay loam. In places the subsoil is thicker. In many areas, the upper part of the subsoil has been plowed into the surface soil and the surface layer is dark grayish brown clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Gorin soils and the well drained Goss and Lindley soils. Gorin soils have a lower content of glacial sand and gravel than the Keswick soil. They are on the higher side slopes. The cherty Goss soils are on the lower side slopes. Lindley soils have less clay than the Keswick soil. They are on side slopes below the Keswick soil. Also included are areas at the head of drainageways near the major drainage divides where the subsoil is gray clay. Included soils make up 2 to 10 percent of the unit.

Permeability is slow in the Keswick soil. Surface runoff is medium in cultivated areas. The available water capacity is moderate. Natural fertility is low, and the organic matter content is moderately low. A perched water table is at a depth of 1 to 3 feet during most winter and spring months. The shrink-swell potential is high. The surface layer is friable and can be fairly easily tilled, but it tends to crust after hard rains, especially in areas where the plow layer contains subsoil material.

Most areas are used for cultivated crops, pasture, or woodland. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, further erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops (fig. 10). Some type of grade stabilization structure generally is needed in conjunction with grassed waterways.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss. Overgrazing should be avoided.

A few areas support native hardwoods. This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suited to building site development if proper design and installation procedures are used. Basements, foundations, and footings should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to

Figure 10.—Baled hay in an area of Keswick loam, 5 to 9 percent slopes, eroded.

prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is not suitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled. Sealing the bottom and berms of the lagoon helps to prevent seepage. Also, sewage can be piped to the adjacent areas where the soils are better suited to onsite waste disposal.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

22D2—Keswick loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on convex side slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown, friable loam about 5 inches thick. The subsoil is about 46 inches thick. In sequence downward, it is dark brown and dark yellowish brown, mottled, friable clay loam; strong brown, mottled, firm clay loam; mottled dark brown, red, yellowish brown, and grayish brown, firm clay loam; and yellowish brown, mottled, firm clay loam and clay. The substratum to a depth of 60 inches or more is mottled yellowish brown, dark brown, light brownish gray, and dark yellowish brown, firm clay loam. In many small areas, the upper part of the subsoil has been mixed with the surface soil by plowing and the surface layer is dark grayish brown clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Gorin soils and the well drained Goss and Lindley soils. Gorin soils have a lower content of glacial sand and gravel than the Keswick soil. They are on the higher side slopes. The cherty Goss soils are on the lower side slopes. Lindley soils have less clay than the Keswick soil. They are on side slopes below the Keswick soil. Also included are areas at the head of drainageways near the major drainage divides where the subsoil is gray clay. Included soils make up 2 to 10 percent of the unit.

Permeability is slow in the Keswick soil. Surface runoff is rapid in cultivated areas. The available water capacity is moderate. Natural fertility is low, and the organic matter content is moderately low. A perched table is at a depth of 1 to 3 feet during most winter and spring months. The shrink-swell potential is high. The surface layer is friable and can be fairly easily tilled, but it tends to crust after hard rains, especially in areas where the plow layer contains subsoil material.

Most areas are used for pasture, hay, or woodland. This soil is suited to cultivated crops only if the crops are grown on a limited basis and an adequate system of conservation tillage is applied. Erosion is a severe hazard if the soil is overused for cultivated crops. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion is the main problem. A good ground cover is necessary at all times if production is to be maintained. Nurse crops help to prevent excessive soil loss in newly seeded areas. Timely tillage is needed. Also, the soil should be tilled on the contour. No-till seeding methods help to protect the surface. Overgrazing should be avoided.

Many areas support native hardwoods, dominantly good-quality white oak. This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suited to building site development if proper design and installation procedures are used. Basements, foundations, and footings should be constructed with adequately reinforced concrete, which helps to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Some land shaping may be necessary to modify the slope. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is not suited to conventional septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled. Also, sewage can be piped to the adjacent areas where the soils are better suited to onsite waste disposal.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, frost action, and the wetness are the main limitations. Some cutting and filling may be necessary because of the slope. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IVe. The woodland ordination symbol is 3C.

24D—Lindley loam, 9 to 14 percent slopes. This deep, strongly sloping, well drained soil is on the convex side slopes of narrowly dissected ridges in the uplands. Individual areas are irregular in shape and range from 5 to 20 acres in size.

Typically, the surface layer is dark brown, friable loam about 7 inches thick. The subsoil is strong brown, mottled, firm clay loam about 29 inches thick. The substratum to a depth of 60 inches or more is strong brown, mottled, firm clay loam. In some places the subsoil is much thinner. In other places, the upper part of the subsoil has been plowed into the surface soil and the surface layer is brown or yellowish brown clay loam.

Included with this soil in mapping are small areas of the cherty Goss soils and the moderately well drained Keswick soils. Goss soils are on side slopes below the Lindley soil. Keswick soils are redder than the Lindley soil and have more clay. They are in the higher landscape positions. Also included are areas at the head of drainageways near the major drainage divides where the subsoil is gray clay. Included soils make up 2 to 15 percent of the unit.

Permeability is moderately slow in the Lindley soil. Surface runoff is rapid. The available water capacity is moderate. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a moderate range in moisture content.

Most areas are used as pasture or woodland. This soil is suited to cultivated crops only if the crops are grown on a limited basis and an adequate system of conservation tillage is applied. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-grown pasture and hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation is the main management problem. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Some areas support large stands of native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development if proper design and installation procedures are used. Basement walls, foundations, and footings should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Some land shaping may be necessary to overcome the slope. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

Because of the restricted permeability, septic tank absorption fields should be enlarged. Sewage lagoons can function adequately if the site is leveled.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, and frost action are the main limitations. Some cutting and filling may be necessary because of the slope. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IVe. The woodland ordination symbol is 3A.

24D2—Lindley clay loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, well drained soil is on the convex side slopes of narrowly dissected ridges in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 5 to 20 acres in size.

Typically, the surface layer is dark brown, friable clay loam about 5 inches thick. The subsoil is strong brown, mottled, firm clay loam about 25 inches thick. The substratum to a depth of 60 inches or more is strong brown, mottled, firm clay loam. In some areas, the upper part of the subsoil has been plowed into the surface soil and the surface layer is dark yellowish brown clay loam. In a few uneroded areas, the surface layer is very dark grayish brown.

Included with this soil in mapping are small areas of the cherty Goss soils and the moderately well drained Keswick soils. Goss soils are on side slopes below the Lindley soil. Keswick soils are redder than the Lindley soil and have more clay. They are in the higher landscape positions. Also included are areas at the head of drainageways near the major drainage divides where the subsoil is gray clay. Included soils make up 2 to 10 percent of the unit.

Permeability is moderately slow in the Lindley soil. Surface runoff is rapid. The available water capacity is moderate. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. The surface layer is friable.

Most areas are used as pasture or woodland. This soil is suited to cultivated crops only if the crops are grown on a limited basis and an adequate system of conservation tillage is applied. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-grown pasture and hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Seed should be planted early so that a good ground cover can be established before the end of the growing season.

Figure 11.—Tall fescue pasture in an area of Lindley clay loam, 9 to 14 percent slopes, eroded.

A cover of pasture plants is effective in controlling erosion (fig. 11). This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management concerns. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Some areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development if proper design and installation procedures are used. Basement walls, foundations, and footings should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Some land shaping may be necessary to overcome the slope. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

Because of the restricted permeability, septic tank absorption fields should be enlarged. Sewage lagoons can function adequately if the site is leveled.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, and frost action are the main limitations. Some cutting and filling may be necessary because of the slope. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IVe. The woodland ordination symbol is 3A.

24F—Lindley loam, 14 to 30 percent slopes. This deep, moderately steep and steep, well drained soil is on convex side slopes and along narrowly dissected drainageways in the uplands. Individual areas are irregular in shape and range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray, friable loam about 1 inch thick. The subsurface layer is brown, mottled, friable loam about 4 inches thick. The subsoil is firm clay loam about 45 inches thick. The upper part is strong brown, and the lower part is strong brown and yellowish brown and is mottled. The substratum to a depth of 60 inches or more is strong brown, mottled, firm clay loam.

Included with this soil in mapping are small areas of the cherty Goss soils. These soils are on side slopes below the Lindley soil. Also included are areas at the head of drainageways near the major drainage divides where the subsoil is gray clay and areas near the base of long slopes where the soil is shallow over shale. Included soils make up 2 to 10 percent of the unit.

Permeability is moderately slow in the Lindley soil. Surface runoff is rapid. The available water capacity is moderate. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. The surface layer is friable.

Most areas support stands of native hardwoods, mainly good-quality white oak. This soil is suited to trees. Because of the slope, the hazard of erosion and the equipment limitation are major management concerns that affect planting and harvesting. Carefully designing logging roads and skid trails can minimize the steepness and length of slopes and the concentration of water. Seeding of disturbed areas may be necessary after harvesting is completed. The roads and skid trails should be constructed on the contour. In the steepest areas the logs should be yarded uphill to the roads and skid trails. Hand planting or direct seeding may be needed. New timber stands should be protected from fire and grazing. Good woodland management can improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope. The cost of designing and preparing the site for construction can be prohibitive.

The land capability classification is VIIe. The woodland ordination symbol is 3R.

25—Marion silt loam. This deep, nearly level, somewhat poorly drained soil is on narrow ridgetops in the uplands. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 2 inches thick. The subsurface layer is friable silt loam about 9 inches thick. It is brown and mottled in the upper part and light gray in the lower part. The subsoil is about 31 inches thick. The upper part is brown and yellowish brown, mottled, very firm silty clay, and the lower part is light brownish gray, mottled, very firm silty clay loam. The substratum to a depth of 60 inches or more is light brownish gray, mottled, firm silty clay loam. In some areas, the upper part of the subsoil has been plowed into the surface soil and the surface layer is brown silt loam.

Included with this soil in mapping are small areas of the gently sloping Gorin and Hatton soils on ridgetops. These soils are not characterized by abrupt textural change. They make up 2 to 10 percent of the unit.

Permeability is very slow in the Marion soil. Surface runoff is slow in cultivated areas. Natural fertility is low, and the organic matter content is moderately low. The available water capacity is moderate. A perched water table is at a depth of 1 to 2 feet during most winter and spring months. The shrink-swell potential is high. The surface layer is friable and can be easily tilled. Root development is somewhat restricted by the wet, clayey subsoil.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and small grain. Insufficient soil moisture commonly affects row crops during the summer. High plant populations of corn and grain sorghum should be avoided. Under natural conditions, the soil is quite acid and is low in fertility. Applications of lime and fertilizer are needed. Returning crop residue to the soil or adding other organic material improves fertility and increases the rate of water infiltration. A surface drainage system can improve most fields.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Deep-rooted legumes, such as alfalfa, do not grow well because of the poor internal drainage. Overgrazing or grazing during wet periods causes surface compaction and thus restricts the rate of water infiltration.

This soil is suited to trees. The equipment limitation, seedling mortality, and windthrow are management concerns. Equipment should be used only during periods when the soil is dry and firm or during periods in winter when the ground is frozen. Ridging the soil and then planting container-grown nursery stock on the ridges increase the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suited to building site development if proper design and installation procedures are used. A surface drainage system is needed. Foundations and footings should be constructed with adequately reinforced concrete, which helps to prevent the structural damage caused by shrinking and swelling. Building on raised, well compacted fill material and installing drainage tile around the footings help to prevent the damage caused by excessive wetness. A proper tile outlet is not readily available in some areas. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Constructing the roads on raised, well compacted fill material, grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIw. The woodland ordination symbol is 2W.

27B—Mexico silt loam, 1 to 5 percent slopes. This deep, very gently sloping and gently sloping, somewhat poorly drained soil is on convex ridgetops in the uplands. Individual areas are irregular in shape and range from 20 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The next 2 inches is dark grayish brown and red, friable silty clay loam that has coatings of brown silt loam. The subsoil is about 36 inches thick. The upper part is dark grayish brown, mottled, firm silty clay loam and silty clay, and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of 60 inches or more is light brownish gray, mottled, firm clay loam. In some places the dark surface layer is less than 6 inches thick. In other places the lower part of the subsoil has more sand.

Included with this soil in mapping are small areas of Armstrong soils. These soils have glacial sand and gravel. They are on side slopes below the Mexico soil. They make up 2 to 10 percent of the unit.

Permeability is very slow in the Mexico soil. Surface runoff is medium in cultivated areas. The available water capacity is high. Natural fertility is medium, and the organic matter content is moderate. A perched water table is at a depth of 1.0 to 2.5 feet during most winter and spring months. The surface layer is friable and can be easily tilled throughout a moderate range in moisture content. It tends to crust or puddle, however, after hard rains, especially in areas where the plow layer contains subsoil material. Root development is somewhat restricted by the silty clay in the subsoil.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface (fig. 12), winter cover crops, a combination of terraces and grassed waterways or tile outlets, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Special management may be needed in areas where terracing has exposed the clayey subsoil. In these areas, tilling the soil is difficult and fertility and the available water capacity are low. These limitations can be minimized by stockpiling the topsoil from the area where the terrace is to be constructed and redistributing it over the exposed clayey area. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. The soil is suitable for irrigation, but the wetness and the slope are limitations.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss. Overgrazing or grazing when the soil is too wet causes surface compaction.

This soil is suited to building site development if proper design and installation procedures are used.

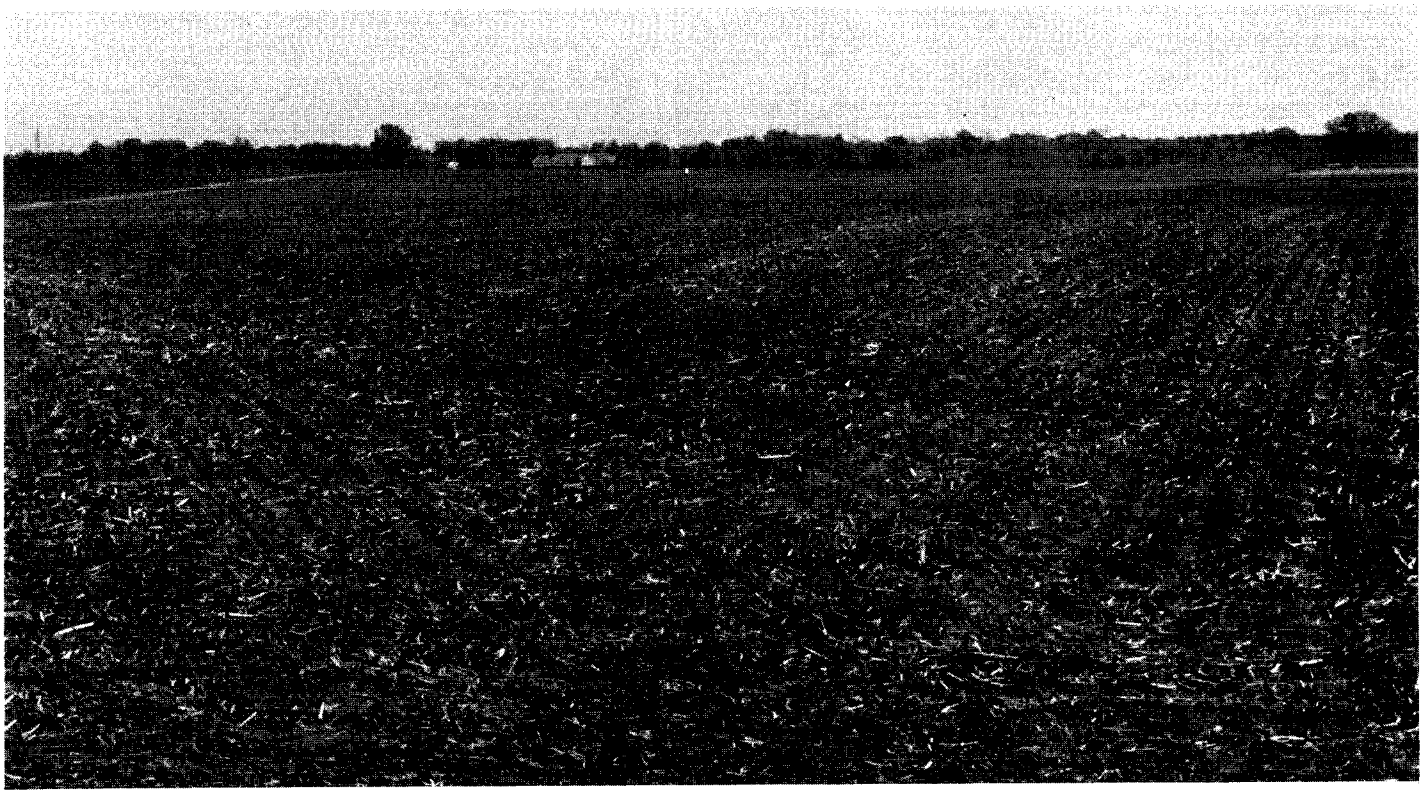

Figure 12.—An area of Mexico silt loam, 1 to 5 percent slopes, where a system of conservation tillage has been applied.

Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings can help to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIe. No woodland ordination symbol is assigned.

27B2—Mexico silt loam, 1 to 5 percent slopes, eroded. This deep, very gently sloping and gently sloping, somewhat poorly drained soil is on convex ridgetops and side slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 30 inches thick. The upper part is grayish brown, mottled, firm silty clay, and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of 60 inches or more is light brownish gray, mottled, firm silty clay loam. In some places, the upper part of the subsoil has been plowed into the surface soil and the surface layer is dark grayish brown silty clay loam. In other places the lower part of the subsoil has more sand and pebbles.

Included with this soil in mapping are small areas of Armstrong soils. These soils have glacial sand and gravel. They are on side slopes below the Mexico soil. Also included are some scattered areas where the soil is severely eroded and the surface layer is grayish brown silty clay. Included soils make up 2 to 10 percent of the unit.

Permeability is very slow in the Mexico soil. Surface runoff is medium in cultivated areas. The available water capacity is moderate. Natural fertility is medium, and the organic matter content is moderate. A perched water table is at a depth of 1.0 to 2.5 feet during most winter and spring months. The surface layer is friable and can be easily tilled when moisture conditions are favorable. It tends to crust or puddle, however, after hard rains, especially in areas where the plow layer contains subsoil material. Root development is somewhat restricted by the silty clay in the subsoil.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, a combination of terraces and grassed waterways or tile outlets, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. The soil is suitable for irrigation, but the wetness and the slope are limitations.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss. Overgrazing or grazing when the soil is too wet causes surface compaction.

This soil is suited to building site development if proper design and installation procedures are used. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings can help to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

28A—Moniteau silt loam, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, poorly drained soil is on narrow flood plains. It is occasionally flooded. Individual areas are irregular in shape and range from 10 to 30 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 10 inches thick. The subsoil is mottled, firm silty clay loam about 37 inches thick. The upper part is dark gray, and the lower part is grayish brown. The substratum to a depth of 60 inches or more is gray, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Belknap soils. These soils do not have a subsoil. They make up 2 to 10 percent of the unit.

Permeability is moderately slow in the Moniteau soil. Surface runoff is slow in cultivated areas. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. A perched water table is within a depth of 1 foot during most winter and spring months. The surface layer is friable, but it can be easily tilled only at the optimum moisture content. It tends to crust or puddle after hard rains.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Crop damage can be expected during some years because of the flooding. Wetness is a limitation. Shallow ditches and land grading can improve drainage in large areas. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is well suited to the commonly grown legumes, such as red clover, ladino clover, and lespedeza; cool-season grasses, such as reed canarygrass; and warm-season grasses, such as switchgrass. The perched water table is a problem during planting and harvesting. Plants should be selected accordingly. A seedbed can be easily prepared. A drainage system is beneficial, especially if deep-rooted species are grown. Flood damage is slight in areas used as pasture or hayland. Overgrazing or grazing when the soil is too wet causes surface compaction.

Some areas support small stands of native hardwoods. This soil is suited to trees. The equipment limitation, seedling mortality, and windthrow are management concerns that affect planting and harvesting. Equipment should be used only during periods when the topsoil is dry and firm or during periods in winter when the ground is frozen. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is unsuitable for building site development and onsite waste disposal because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

29—Landes loam. This deep, nearly level, well drained soil is on flood plains along the major streams. It is frequently flooded. Individual areas are irregular in shape and range from 5 to 20 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loam about 4 inches thick. The subsurface layer also is very dark grayish brown, very friable loam. It is about 8 inches thick. The substratum extends to a depth of 60 inches or more. The upper part is dark yellowish brown, mottled, very friable fine sandy loam. The lower part is brown, mottled, very friable and friable fine sandy loam.

Included with this soil in mapping are areas of Cedargap and Haymond soils. These soils are adjacent to the streams. They have less sand than the Landes soil. Cedargap soils have chert below a depth of about 7 inches. Haymond soils are silty throughout. Also included are areas in old stream channels and on swells where the surface layer is gravelly or cherty. Included soils make up 2 to 10 percent of the unit.

Permeability is moderately rapid in the Landes soil. Surface runoff is slow in cultivated areas. The available water capacity is moderate. Natural fertility is low, and the organic matter content is moderately low. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. If cultivated crops are planted, the frequent flooding and resulting crop damage are hazards unless the soil is protected. Insufficient soil moisture is common during summer. Returning crop residue to the soil or regularly adding other organic material can improve fertility, minimize surface crusting, and increase the available water capacity.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as Caucasian bluestem and switchgrass. Insufficient soil moisture during summer and flooding are the main problems. Planting species that can withstand flooding helps to maintain the stand. Overgrazing should be avoided.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is unsuitable for building site development and onsite waste disposal because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 10A.

31—Haymond silt loam. This deep, nearly level, well drained soil is on flood plains near stream channels. It is occasionally flooded. Individual areas are irregular in shape and range from 10 to 40 acres in size.

Typically, the surface layer is dark brown, very friable silt loam about 7 inches thick. The substratum to a depth of 60 inches or more is very friable silt loam. The upper part is stratified dark brown and brown, and the lower part is brown and mottled.

Included with this soil in mapping are small areas of Landes soils. These soils have more sand than the Haymond soil. They are frequently flooded and are in areas adjacent to the stream channels. They make up 10 to 15 percent of the unit.

Permeability is moderate in the Haymond soil. Surface runoff is very slow in cultivated areas. The available water capacity is high. Natural fertility is medium, and the organic matter content is moderate. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain where short-duration flooding is not a problem. If cultivated crops are grown, spring flooding and wetness can delay spring tillage. Fall plowing may subject the soil to scouring during periods of flooding.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; cool-season grasses, such as tall fescue and orchardgrass; and warm-season grasses, such as big bluestem and switchgrass. The species that can withstand flooding grow best. Flooding is not a serious problem because it is usually of short duration, but it should be considered when grazing systems are designed.

A few small areas support native hardwoods, especially along stream channels. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is unsuitable for building site development and onsite waste disposal because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 9A.

32—Cedargap loam. This deep, nearly level, well drained soil is on flood plains in areas where small streams widen out into larger streams. It is frequently flooded. Individual areas generally are narrow and elongated and range from 2 to 20 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. The subsurface layer is dark brown, friable very cherty loam about 17 inches thick. The substratum extends to a depth of 60 inches or more. The upper part is dark brown, friable very cherty loam, and the lower part is dark brown and brown, friable extremely cherty loam. In places the lower part of the substratum is cherty loamy sand.

Included with this soil in mapping are small areas of the chert-free Haymond soils. These soils have a surface layer of silt loam. They make up 2 to 10 percent of the unit.

Permeability is moderately rapid in the Cedargap soil. Surface runoff is slow. The available water capacity is moderate. Natural fertility is medium, and the organic matter content is moderate.

Most areas are used as pasture. They generally are narrow and are not easily accessible. As a result, row crops generally cannot be grown. This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as Caucasian bluestem and switchgrass. Insufficient soil moisture during summer and flooding are the main problems. Planting species that can withstand flooding helps to maintain the stand.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is unsuitable for building site development and onsite waste disposal because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 3A.

33—Belknap silt loam. This deep, nearly level, somewhat poorly drained soil is on the flood plains along the Missouri River and its tributaries. It is occasionally flooded. Individual areas are irregular in shape and range from 10 to 30 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 13 inches thick. The substratum to a depth of 60 inches or more is mottled, friable silt loam. The upper part is dark grayish brown and grayish brown, and the lower part is light brownish gray, grayish brown, and light gray. In some areas, the upper part of the substratum has been plowed into the surface soil and the surface layer is grayish brown silt loam or silty clay loam.

Included with this soil in mapping are small areas of Dupo, Moniteau, and Waldron soils. Dupo soils typically are silt loam in the upper part and silty clay loam in the lower part. They are on alluvial fans adjacent to the upland bluffs. Moniteau soils have more clay than the Belknap soil. They are poorly drained and are on low terraces. Waldron soils have more clay than the Belknap soil and are dominantly neutral. They are in the lower positions on the flood plains along the Missouri River. Included soils make up 2 to 5 percent of the unit.

Permeability is moderate in the Belknap soil. Surface runoff is slow in cultivated areas. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. The seasonal high water table is at a depth of 1 to 3 feet during most winter and spring months. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and small grain. Wetness is a limitation. It can be reduced by installing a surface drainage system and by building diversions to keep water from the higher elevations from running onto this soil. Flooding does not cause crop damage in most years. Returning crop residue to the soil helps to maintain fertility and tilth.

This soil is well suited to most of the commonly grown legumes, such as red clover, ladino clover, and lespedeza; cool-season grasses, such as reed canarygrass; and warm-season grasses, such as switchgrass. The seasonal high water table is the main problem. Plants should be selected accordingly. A seedbed can be easily prepared. A drainage system is beneficial, especially if deep-rooted species are grown. Overgrazing or grazing when the soil is too wet causes surface compaction and thus deterioration of tilth.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is unsuitable for building site development and onsite waste disposal because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 6A.

34—Putnam silt loam. This deep, nearly level, poorly drained soil is on broad upland divides. Individual areas are irregular in shape and range from 40 to 400 acres in size.

Typically, the surface layer is very dark grayish brown, mottled, friable silt loam about 7 inches thick. The subsurface layer is grayish brown and light brownish gray, mottled, friable silt loam about 7 inches thick. The subsoil is about 27 inches thick. The upper part is dark grayish brown, mottled, firm silty clay, and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of 60 inches or more is mottled, firm silty clay loam. It is grayish brown in the upper part and dark gray in the lower part. In places, the upper part of the subsurface layer has been mixed with the surface soil by cultivation and the surface layer is grayish brown or gray silt loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Mexico soils. These soils do not have a thick layer of grayish material. They are in the more sloping areas. They make up 2 to 10 percent of the unit.

Permeability is very slow in the Putnam soil. Surface runoff is slow in cultivated areas. The available water capacity is high. Natural fertility is medium, and the organic matter content is moderate. A perched water table is at a depth of 0.5 to 1.5 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable, but it can be easily tilled only at optimum moisture conditions. It tends to crust or puddle after heavy rains.

Most areas are used for cultivated crops (fig. 13). This soil is suited to corn, soybeans, and small grain. Wetness is the major limitation. It can delay planting in the spring or harvest in the fall. Shallow ditches and land grading can improve drainage in large areas. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is well suited to shallow-rooted legumes that can tolerate wetness, such as birdsfoot trefoil; cool-season grasses, such as reed canarygrass; and warm-season grasses, such as switchgrass. It is not suited to deep-rooted plants. Overgrazing or grazing when the soil is too wet causes surface compaction and thus deterioration of tilth.

This soil is suited to building site development if proper design and installation procedures are used. Foundations and footings should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings can help to prevent the damage caused by excessive wetness. A surface drainage system generally is needed. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIw. No woodland ordination symbol is assigned.

35C2—Winfield silt loam, 3 to 9 percent slopes, eroded. This deep, gently sloping and moderately sloping, moderately well drained soil is on convex ridgetops and side slopes on uplands bordering the flood plains along the Missouri River. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 7 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is brown, firm silty clay loam; the next part is brown, strong brown, dark brown, and dark yellowish brown, mottled, firm silty clay loam; and the lower part is dark brown, mottled, firm silt loam. In some areas, the upper part of the subsoil has been plowed into the surface soil and the surface layer is yellowish brown silty clay loam.

Included with this soil in mapping are small areas of Weller soils. These soils have more clay in the subsoil than the Winfield soil. They are on the broader ridgetops. They make up less than 5 percent of the unit.

Permeability is moderate in the Winfield soil. Surface runoff is slow or medium in cultivated areas. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. A perched water table is at a depth of 2.5 to 4.0 feet during most winter and spring months. The shrink-swell potential is moderate. The surface layer is friable, but it tends to crust after heavy rains in areas where it is silty clay loam.

Most areas are used as pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, a combination of terraces and grassed waterways or tile outlets, contour farming, and a conservation cropping system that includes close-growing pasture or hay

Figure 13.—An irrigation system in a cultivated area of Putnam silt loam.

crops. Special management may be needed in areas where terracing has exposed the clayey subsoil. In these areas, tilling the soil is difficult and fertility and the available water capacity are low. These limitations can be minimized by stockpiling the topsoil from the area where the terrace is to be constructed and redistributing it over the exposed clayey area. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Properly managing crop residue helps to control erosion, maintain tilth, increase or maintain the content of organic matter, and increase the rate of water intake.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; cool-season grasses, such as smooth brome and orchardgrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

Some areas support native hardwoods, dominantly white oak of good quality. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suitable for building site development if proper design and installation procedures are used. Foundations, footings, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Grading is needed to modify the slope.

This soil generally is not used as a site for septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled and if the bottom and berms are sealed with slowly permeable material, which helps to prevent seepage.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

35D2—Winfield silt loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on convex side slopes on uplands bordering the flood plains along the Missouri River. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Most areas are irregular in shape and range from 20 to 80 acres in size.

Typically, the surface layer is brown, friable silt loam about 2 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is brown, firm silty clay loam; the next part is brown, mottled, firm silty clay loam; and the lower part is brown, mottled, firm silt loam. In some areas, the upper part of the subsoil has been plowed into the surface soil and the surface layer is brown silty clay loam.

Included with this soil in mapping are soils that have chert fragments in the lower part of the subsoil. These soils are on side slopes. Also included are a few areas of limestone outcrops on the lower side slopes and on the edges of drainageways. Included areas make up about 5 percent of the unit.

Permeability is moderate in the Winfield soil. Surface runoff is rapid. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. A perched water table is at a depth of 2.5 to 4.0 feet during most winter and spring months. The shrink-swell potential is moderate. The surface layer is friable, but it tends to crust after heavy rains in areas where it is silty clay loam.

Most areas are used for pasture or hay. This soil is suitable for row crops grown on a limited basis in rotation with small grain and close-growing pasture or hay crops. If row crops are grown year after year, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Properly managing crop residue helps to control erosion, maintain tilth, increase or maintain the content of organic matter, and increase the rate of water intake.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management concerns. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Many areas support stands of native hardwoods, dominantly white oak of good quality. This soil is suited to trees. No major hazards or limitations affect planting or harvesting. In some areas stand improvement and protection from grazing are needed. Good woodland management can improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil is suitable for building site development if proper design and installation procedures are used. Foundations, footings, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. The slope is a limitation on sites for dwellings. The sites can be graded during construction. Some land shaping may be necessary. Also, the buildings can be designed so that they conform to the natural slope of the land.

This soil generally is not used as a site for septic tank absorption fields because of the slope, the restricted permeability, and the wetness. Sewage lagoons can function adequately if the site is leveled and if the bottom and berms of the lagoons are sealed with slowly permeable material, which helps to prevent seepage.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, and frost action are limitations. Some cutting and filling may be necessary because of the slope. Also, the roads can be designed so that they conform to the natural slope of the land. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

35E2—Winfield silt loam, 14 to 20 percent slopes, eroded. This deep, moderately steep, moderately well drained soil is on convex side slopes on uplands bordering the flood plains along the Missouri River. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 20 to 80 acres in size.

Typically, the surface layer is brown, friable silt loam about 4 inches thick. The subsurface layer also is brown, friable silt loam. It is about 3 inches thick. The subsoil to a depth of 60 inches or more is firm silty clay loam. The upper part is dark yellowish brown and yellowish brown, and the lower part is brown, dark yellowish brown, and yellowish brown and is mottled. In some areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Gasconade and Goss soils. These soils are on side slopes below the Winfield soil. Gasconade soils are less than 20 inches deep over limestone bedrock. They are in areas intermingled with outcrops of limestone bedrock. Goss soils are cherty throughout. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Winfield soil. Surface runoff is rapid. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. A perched water table is at a depth of 2.5 to 4.0 feet during most winter and spring months. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled. No restrictions affect root development.

Most areas are wooded. Some areas are used as pasture. This soil is suitable for cultivated crops only if the crops are grown on a limited basis. The slope and a severe hazard of erosion are management concerns. Cultivated crops should be grown only in rotations that include several years of pasture and hay crops. A system of conservation tillage that leaves a protective cover of crop residue on the surface and contour farming help to prevent excessive erosion.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management concerns. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Many areas support stands of native hardwoods, dominantly white oak of good quality. This soil is suited to trees. Because of the slope, the hazard of erosion and the equipment limitation are the major management concerns. Carefully designing logging roads and skid trails can minimize the steepness and length of slopes and the concentration of water. Seeding of disturbed areas may be necessary after harvesting is completed. Operating equipment is hazardous because of the slope. The roads and skid trails should be built on the contour. In the steepest areas the logs should be yarded uphill to the logging roads and skid trails. Hand planting or direct seeding may be needed. Good woodland management can improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil is suitable for building site development if proper design and installation procedures are used. Foundations, footings, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. The slope is a limitation on sites for dwellings. The sites can be graded during construction. Some land shaping may be necessary. Also, the buildings can be designed so that they conform to the natural slope of the land.

This soil generally is not used as a site for septic tank absorption fields because of the slope, the restricted permeability, and the wetness. Sewage lagoons can function adequately if the site is leveled and the bottom and berms of the lagoons are sealed with slowly permeable material, which helps to prevent seepage.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, and frost action are limitations. Some cutting and filling may be necessary because of the slope. Also, the roads can be designed so that they conform to the natural slope of the land. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IVe. The woodland ordination symbol is 3R.

35F2—Winfield silt loam, 20 to 30 percent slopes, eroded. This deep, steep, moderately well drained soil is on convex side slopes on uplands bordering the flood plains along the Missouri River. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 15 to 90 acres in size.

Typically, the surface layer is brown, friable silt loam about 4 inches thick. The subsoil is firm silty clay loam about 46 inches thick. The upper part is brown, and the lower part is yellowish brown and mottled. The substratum to a depth of 60 inches or more is brown, mottled silty clay loam.

Included with this soil in mapping are small areas of Gasconade and Goss soils. These soils are on side slopes below the Winfield soil. Gasconade soils are less than 20 inches deep over limestone bedrock. They are in areas intermingled with outcrops of limestone bedrock. Goss soils are cherty throughout. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Winfield soil. Surface runoff is rapid. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. A perched water table is at a depth of 2.5 to 4.0 feet during most winter and spring months. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled. No restrictions affect root development.

Most areas support stands of native hardwoods. This soil is unsuitable for cultivated crops because of the slope and a severe hazard of erosion. It is suited to trees. Because of the slope, the hazard of erosion and the equipment limitation are the major management concerns. Carefully designing logging roads and skid trails can minimize the steepness and length of slopes and the concentration of water. Seeding of disturbed areas may be necessary after harvesting is completed. Operating equipment is hazardous because of the slope. The roads and skid trails should be built on the contour. In the steepest areas the logs should be yarded uphill to the logging roads and skid trails. Hand planting or direct seeding may be needed. Good woodland management can improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for onsite waste disposal or building site development because of the slope.

The land capability classification is VIe. The woodland ordination symbol is 3R.

37C2—Menfro silt loam, 3 to 9 percent slopes, eroded. This deep, gently sloping and moderately sloping, well drained soil is on convex ridgetops and side slopes on uplands adjacent to the flood plains along the Missouri River. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas generally are long and irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is mixed dark grayish brown and dark brown, friable silt loam about 6 inches thick. The subsoil is dark brown and dark yellowish brown, friable and firm silty clay loam about 44 inches thick. The substratum to a depth of 60 inches or more is yellowish brown, firm silt loam. In places the surface layer is silty clay loam.

Permeability is moderate. Surface runoff is slow or medium. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used as pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, a combination of terraces and grassed waterways or tile outlets, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Properly managing crop residue helps to control erosion, maintain tilth, increase or maintain the content of organic matter, and increase the rate of water intake.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; cool-season grasses, such as smooth brome and orchardgrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

Some areas support native hardwoods. This soil is suited to trees. White oak, black oak, northern red oak, and sugar maple grow well. No major hazards or limitations affect planting or harvesting.

This soil is suitable for building site development if proper design and installation procedures are used. Foundations, footings, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Grading is needed to modify the slope on sites for small commercial buildings.

This soil is suitable as a site for properly installed septic tank absorption fields. Because of the restricted permeability, the absorption fields should be enlarged. Sewage lagoons can function adequately if the bottom and berms of the lagoons are sealed with slowly permeable material, which helps to prevent seepage.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

37D2—Menfro silt loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, well drained soil is on convex side slopes on uplands adjacent to the flood plains along the Missouri River. The side slopes commonly are cut by many small drainageways that run into the adjacent larger drainageways. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are long and irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is dark brown silt loam about 8 inches thick. The subsoil to a depth of 60 inches or more is firm silty clay loam. The upper part is brown, and the lower part is dark yellowish brown. In places the surface layer is silty clay loam.

Included with this soil in mapping are soils that have chert fragments in the lower part of the subsoil. These soils are on side slopes. Also included are a few areas of limestone outcrops on the lower side slopes and on the edges of drainageways. Included areas make up about 5 percent of the unit.

Permeability is moderate in the Menfro soil. Surface runoff is rapid. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops, hay, or pasture. This soil is suitable for row crops grown on a limited basis in rotation with small grain and close-growing pasture or hay crops. If row crops are grown year after year, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Properly managing crop residue helps to control erosion, maintain tilth, increase or maintain the content of organic matter, and increase the rate of water intake.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management concerns. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Many areas support stands of native hardwoods, dominantly white oak, black oak, and northern red oak. This soil is suited to trees. No major hazards or limitations affect planting or harvesting. Stand improvement and protection from grazing are needed in the existing stands. Good woodland management can improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil is suitable for building site development if proper design and installation procedures are used. Foundations, footings, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. The slope is a limitation on sites for dwellings. The sites can be graded during construction. Some land shaping may be necessary. Also, the buildings can be designed so that they conform to the natural slope of the land.

This soil is suitable for sewage lagoons if the site is leveled. Sealing the bottom and berms of the lagoons with slowly permeable material helps to prevent seepage. Septic tank absorption fields can function adequately if the laterals are properly installed across the slope. Because of the restricted permeability, the absorption fields should be enlarged.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, and frost action are limitations. Some cutting and filling may be necessary because of the slope. Also, the roads can be designed so that they conform to the natural slope of the land. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing

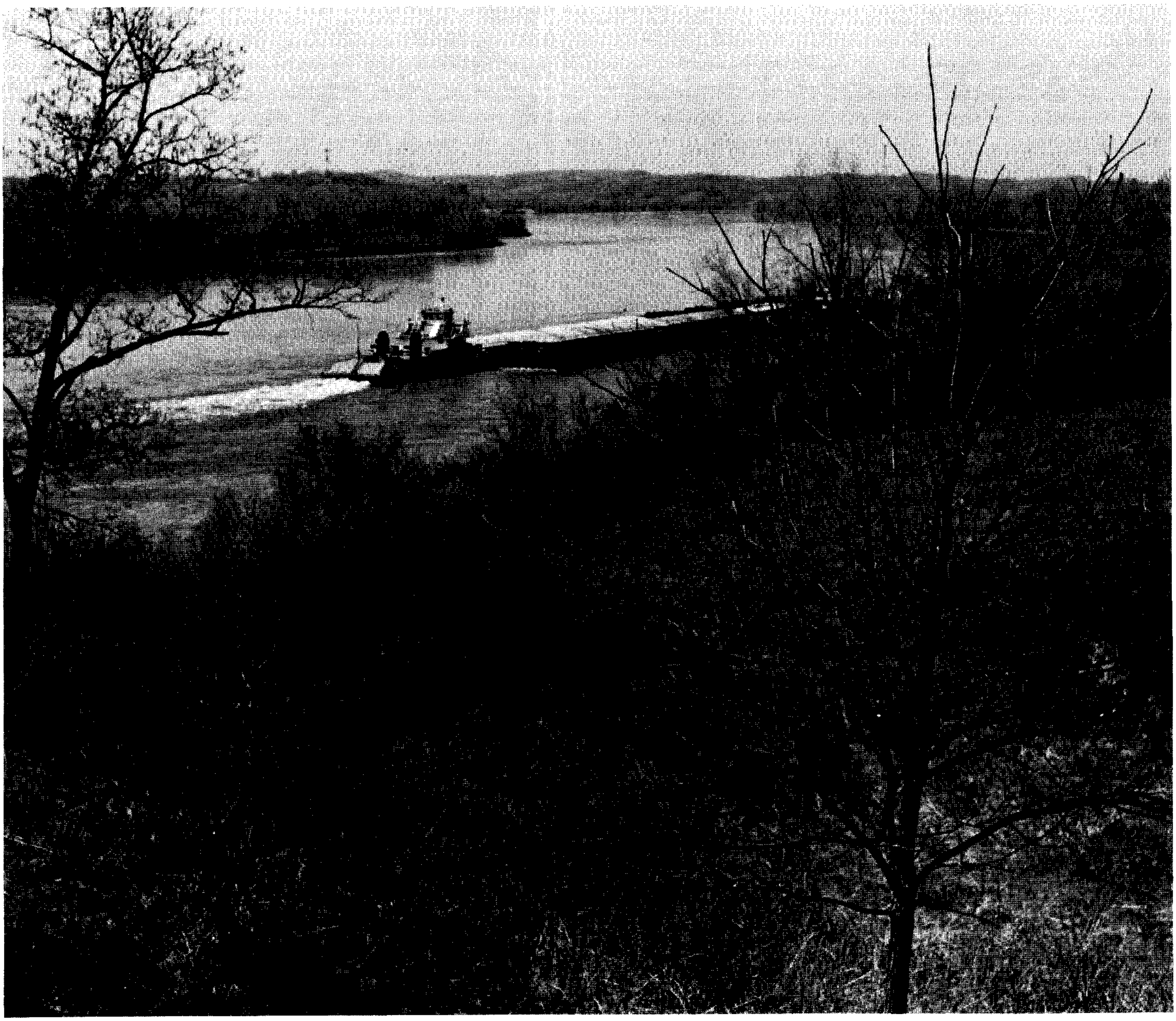

Figure 14.—An area of Menfro silt loam, 14 to 20 percent slopes, eroded, overlooking the Missouri River.

culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

37E2—Menfro silt loam, 14 to 20 percent slopes, eroded. This deep, moderately steep, well drained soil is on convex, uneven side slopes on uplands adjacent to the flood plains along the Missouri River (fig. 14). Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 20 to more than 80 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 4 inches thick. The subsoil is firm silty clay loam about 50 inches thick. The upper part is strong brown and dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of 60 inches or more is yellowish brown silt loam. In some areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of

Gasconade and Goss soils and vertical limestone bluffs. Gasconade and Goss soils are on side slopes below the Menfro soil. Gasconade soils are less than 20 inches deep over limestone bedrock. They are in areas intermingled with outcrops of limestone bedrock. Goss soils have more clay than the Menfro soil and are cherty throughout. Also included, on the lower side slopes that face the flood plains along the Missouri River, are pockets of loose sand. Included areas make up about 5 to 10 percent of the unit.

Permeability is moderate in the Menfro soil. Surface runoff is rapid. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas are used for pasture or hay. A few areas are used for cultivated crops. This soil is suitable for cultivated crops only if the crops are grown on a limited basis. The slope and a severe hazard of erosion are management concerns. Cultivated crops should be grown only in rotations that include several years of pasture and hay crops. A system of conservation tillage that leaves a protective cover of crop residue on the surface and contour farming help to prevent excessive erosion.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management concerns. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Many areas support stands of native hardwoods, dominantly white oak of good quality. This soil is suited to trees. Because of the slope, the hazard of erosion and the equipment limitation are management concerns. Carefully designing logging roads and skid trails can minimize the steepness and length of slopes and the concentration of water. Seeding of disturbed areas may be necessary after harvesting is completed. Operating equipment is hazardous because of the slope. The roads and skid trails should be built on the contour. In the steepest areas the logs should be yarded uphill to the logging roads and skid trails. Hand planting or direct seeding may be needed.

This soil is suitable for building site development if proper design and installation procedures are used. Foundations, footings, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. The slope is a limitation on sites for dwellings. The sites can be graded during construction. Also, the dwellings can be designed so that they conform to the natural slope of the land.

This soil is suitable for sewage lagoons if the site is leveled. Sealing the bottom and berms of the lagoons with slowly permeable material helps to prevent seepage.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, and frost action are limitations. Some cutting and filling may be necessary because of the slope. Also, the roads can be designed so that they conform to the natural slope of the land. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IVe. The woodland ordination symbol is 3R.

37F2—Menfro silt loam, 20 to 30 percent slopes, eroded. This deep, steep, well drained soil is on side slopes on uplands adjacent to the flood plains along the Missouri River. Drainageways are deeply cut into the landscape, and large gullies are common. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 10 to more than 60 acres in size.

Typically, the surface layer is brown silt loam about 3 inches thick. The subsoil is brown, firm silty clay loam about 45 inches thick. The substratum to a depth of 60 inches or more is yellowish brown, friable silt loam.

Included with this soil in mapping are small areas of Gasconade and Goss soils and vertical limestone bluffs. Gasconade and Goss soils are on side slopes below the Menfro soil. Gasconade soils are less than 20 inches deep over limestone bedrock. They are in areas intermingled with outcrops of limestone bedrock. Goss soils have more clay than the Menfro soil and are cherty throughout. Also included, on the lower side slopes that face the flood plains along the Missouri River, are pockets of loose sand. Included areas make up about 5 to 10 percent of the unit.

Permeability is moderate in the Menfro soil. Surface runoff is very rapid. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate.

Most areas support stands of native hardwoods, dominantly white oak, black oak, and northern red oak. This soil is unsuitable for cultivated crops because of the slope and a severe hazard of erosion. It is suited to trees. The slope, the hazard of erosion, and the equipment limitation are the major management concerns. Carefully designing logging roads and skid trails can minimize the steepness and length of slopes and the concentration of water. Seeding of disturbed areas may be necessary after harvesting is completed. Operating equipment is hazardous because of the slope. The roads and skid trails should be built on the contour. In the steepest areas the logs should be yarded uphill to the logging roads and skid trails. Hand planting or direct seeding may be needed.

This soil generally is not used for onsite waste disposal or building site development because of the slope.

The land capability classification is VIe. The woodland ordination symbol is 3R.

39—Hodge fine sand, loamy substratum. This deep, nearly level, somewhat excessively drained soil is on flood plains along the Missouri River. It is frequently flooded. Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is dark brown, loose fine sand about 8 inches thick. The substratum extends to a depth of 60 inches or more. The upper part is dark grayish brown, loose fine sand; the next part is dark grayish brown, loose loamy fine sand; and the lower part is stratified dark grayish brown, grayish brown, and brown, friable silt loam. In some areas the soil has finer textured strata at a depth of about 2 feet.

Included with this soil in mapping are small areas of the well drained Grable soils on broad natural levees and the somewhat poorly drained Leta soils on low ridges. Grable soils are not so sandy as the Hodge soil, and Leta soils have more clay. Also included are areas of Hodge soils that are leveled and are subject to rare flooding. Included areas make up 5 to 10 percent of the unit.

Permeability is rapid in the Hodge soil. Surface runoff is slow in cultivated areas. The available water capacity is low. Natural fertility and the organic matter content also are low. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Nearly all areas are used for row crops. Because of the low available water capacity, this soil is not well suited to cultivated crops. It is droughty and is subject to soil blowing during periods of low rainfall. Irrigation, however, can greatly improve the productivity of this soil. Frequent sprinkler irrigation is necessary for the best results. Grain sorghum and alfalfa respond well to irrigation. Irrigation and the use of heavy equipment can result in compaction, which can restrict root penetration and reduce yields. Occasional deep cultivation helps to overcome this limitation. Soil blowing can be controlled by plowing only in spring or minimizing tillage in areas used for summer crops or by planting a cover crop after the fall harvest. The organic matter content can be increased by applying manure or by plowing under green manure crops, such as sudangrass.

This soil is suited to trees and to habitat for woodland wildlife, including white-tailed deer and small game. Areas that are not protected from flooding are best suited to those uses. Seedling mortality is a management concern. Planting container-grown nursery stock increases the seedling survival rate.

This soil is unsuitable for building site development and onsite waste disposal because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 13S.

40—Grable very fine sandy loam, loamy substratum. This deep, nearly level, well drained soil is on flood plains along the Missouri River. Most areas are protected by levees but are subject to rare flooding because of levee breaks or runoff from the adjacent areas. Individual areas are generally wide and long and range from 20 to more than 500 acres in size.

Typically, the surface layer is very dark grayish brown, very friable very fine sandy loam about 8 inches thick. The substratum extends to a depth of 60 inches or more. The upper part is brown, mottled, very friable very fine sandy loam; the next part is brown, loose fine sand; and the lower part is stratified brown and dark grayish brown, mottled, very friable loamy fine sand to silt loam. In places the surface layer is silt loam.

Included with this soil in mapping are the somewhat excessively drained Hodge soils in long, narrow areas adjacent to the river and the somewhat poorly drained Leta soils on low ridges. Hodge soils have more sand than the Grable soil, and Leta soils have more clay. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Grable soil, rapid in the next part, and moderately rapid in the lower part. Surface runoff is slow in cultivated areas. The available water capacity is moderate. Natural fertility is medium, and the organic matter content is moderately low. The surface layer is friable and can be very easily tilled throughout a wide range in moisture content.

Nearly all areas are used for row crops. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay or pasture. Where the soil is protected from flooding, the amount of water available to plants is a moderate limitation affecting summer crops.

This soil generally is not used for building site development or onsite waste disposal because of the flooding.

The land capability classification is IIs. No woodland ordination symbol is assigned.

41—Leta silty clay loam, sandy substratum. This deep, nearly level, somewhat poorly drained soil is at intermediate elevations on the flood plains along the Missouri River. It is protected by levees but is subject to rare flooding because of levee breaks or runoff from local tributaries. Individual areas are elongated and range from 5 to 425 acres in size.

Typically, the surface layer is very dark grayish brown, firm silty clay loam about 6 inches thick. The subsurface layer also is very dark grayish brown, firm silty clay loam. It is about 5 inches thick. The subsoil is very dark grayish brown and dark grayish brown, mottled, firm silty clay loam about 14 inches thick. The substratum extends to a depth of 72 inches or more. The upper part is dark grayish brown, mottled, friable very fine sandy loam; the next part is stratified grayish brown, mottled, friable very fine sandy loam and silt loam; and the lower part is grayish brown, loose fine sand. In some areas the soil is shallower to the substratum. In a few places the surface layer is silty clay or silt loam.

Included with this soil in mapping are some small areas of the well drained Grable soils close to the river and some small, elongated areas of Waldron soils in depressions and old sloughs. Grable soils have more sand than the Leta soil, and Waldron soils have more clay. Included soils make up 2 to 10 percent of the unit.

Permeability is slow in the clayey upper part of the Leta soil and moderate in the loamy lower part. Surface runoff is slow in cultivated areas. The available water capacity is high. Natural fertility also is high, and the organic matter content is moderate. The seasonal high water table is at a depth of 1 to 3 feet during most winter and spring months. The shrink-swell potential is moderate in the surface layer and subsurface layer, high in the subsoil, and low in the substratum. The surface layer is very firm when dry and sticky when wet and becomes cloddy if it is tilled when too wet or too dry. It should be tilled only at the optimum moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Wetness is a limitation. Open ditches, shallow surface drains, and land grading help to remove excess water. Fall plowing improves tilth and the ease with which the soil is worked in spring. Center-pivot irrigation systems work well, but the intake may be slow and some wetness may occur. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, improves tilth, and increases the rate of water infiltration.

This soil is well suited to the commonly grown legumes, such as red clover, ladino clover, and lespedeza; cool-season grasses, such as reed canarygrass; and warm-season grasses, such as switchgrass. The seasonal high water table is the main problem. Plants should be selected accordingly. A seedbed can be easily prepared. A drainage system is beneficial, especially if deep-rooted species are grown. Overgrazing or grazing when the soil is wet causes surface compaction.

A few small areas support native hardwoods. This soil is suited to trees. The equipment limitation, seedling mortality, and windthrow are management concerns. Equipment should be used only during periods when the soil is dry or frozen. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil generally is not used for building site development or onsite waste disposal because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 7C.

42—Waldron silty clay, loamy substratum. This deep, nearly level, somewhat poorly drained soil is in the lower areas on the flood plains along the Missouri River. Most areas are protected by levees but are subject to rare flooding because of levee breaks or local runoff. Individual areas are irregular in shape and range from 10 to 380 acres in size.

Typically, the surface layer is very dark gray, firm silty clay about 11 inches thick. The substratum extends to 75 inches or more. The upper part is dark grayish brown and grayish brown, mottled, firm silty clay; the next part is dark gray, mottled, firm silty clay loam; and the lower part is stratified dark brown and dark gray, friable very fine sandy loam and silt loam. In a few places the surface layer is silty clay loam.

Included with this soil in mapping are areas of Booker, Dupo, and Leta soils. The very poorly drained Booker soils are in broad depressions and slack-water areas. They contain more clay than the Waldron soil.

Dupo soils typically are silt loam in the upper part and silty clay loam in the lower part. They are in the higher areas next to bluffs. Leta soils have less clay than the Waldron soil. They are on narrow ridges. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Waldron soil. Surface runoff is slow in cultivated areas. The available water capacity is moderate. Natural fertility is high, and the organic matter content is moderate. A perched water table is at a depth of 1 to 3 feet during most winter and spring months. The shrink-swell potential is high.

Nearly all areas are used for row crops. A few small areas are used for alfalfa or pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. Wetness is the main problem. Excess surface water generally can be removed by a system of shallow field ditches. Land grading also improves drainage and fills potholes.

This soil is well suited to the commonly grown legumes, such as red clover, ladino clover, and lespedeza; cool-season grasses, such as reed canarygrass; and warm-season grasses, such as switchgrass. The perched water table is the main problem. Plants should be selected accordingly. A seedbed can be easily prepared. A drainage system is beneficial, especially if deep-rooted species are grown.

A few small areas support native hardwoods. This soil is suited to trees. The equipment limitation and seedling mortality are management concerns. Equipment should be used only during periods when the soil is dry or frozen. Planting container-grown nursery stock increases the seedling survival rate.

This soil generally is not used for building site development or onsite waste disposal because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 4C.

43—Booker silty clay. This deep, nearly level, very poorly drained soil is along low drainageways and in broad depressional areas on the flood plains along the Missouri River. It is protected by levees but is subject to rare flooding because of levee breaks or runoff from local tributaries. It also is subject to ponding. Individual areas generally are long and range from 15 to several hundred acres in size.

Typically, the surface layer is very dark gray, firm silty clay about 6 inches thick. The subsoil is about 52 inches thick. It is very dark gray, very firm silty clay in the upper part; black, mottled, very firm silty clay and clay in the next part; and very dark gray and dark gray, mottled, very firm clay in the lower part. The substratum to a depth of 75 inches or more is dark gray, mottled, very firm clay. A few areas have overwash of silt loam.

Included with this soil in mapping are small areas of Dupo, Leta, and Waldron soils. Dupo soils have a surface layer of silt loam. They are in areas adjacent to upland bluffs. The somewhat poorly drained Leta and Waldron soils have less clay than the Booker soil. Leta soils are on narrow ridges. Waldron soils are in the slightly higher positions on the landscape. Included soils make up less than 5 percent of the unit.

Permeability is very slow in the Booker soil. Surface runoff is very slow in cultivated areas. Ponding is common after periods of rainfall. The available water capacity is moderate. Natural fertility is high, and the organic matter content is moderate. The seasonal water table is above the surface to 1 foot below the surface during most winter and spring months. The shrink-swell potential is very high. Long, deep cracks form during dry periods. The surface layer is firm and can be easily tilled only within a narrow range in moisture content. It is sticky and cannot be easily tilled when wet or hard and becomes cloddy when dry.

Most areas are used for row crops. A few small areas are used for pasture or hay. This soil is suited to soybeans and winter wheat. Because of wetness during spring and fall, row crops that require a short growing season are the best suited crops. Land grading and shallow surface ditches can improve surface drainage. Root development is restricted by poor aeration and the high water table. Seedbeds should be prepared when the soil is at the optimum moisture content. The soil should be tilled far enough in advance for freezing and thawing or wetting and drying to break up clods.

This soil is moderately suited to shallow-rooted legumes that can tolerate wetness, such as ladino clover and alsike clover, and to cool-season grasses, such as reed canarygrass. It is poorly suited to warm-season grasses and to hay. The wetness and the ponding are the main management concerns. The flooding should be considered when grazing systems are designed. Maintaining stands of desirable species is difficult in depressional areas. A surface drainage system is beneficial, especially if deep-rooted species are grown.

A few areas support native timber. This soil is suited to trees that can tolerate wetness. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Equipment should be used only during periods when the soil is dry or frozen. Ridging the soil and then planting container-grown nursery stock on the ridges increase the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil generally is not used for building site development or onsite waste disposal because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 6W.

44—Dupo silt loam. This deep, nearly level, somewhat poorly drained soil is on alluvial fans and in overwash areas on the flood plains along the Missouri River. It is protected by levees but is subject to rare flooding because of levee breaks or runoff from the adjacent areas. Individual areas are irregular in shape and range from 5 to 170 acres in size.

Typically, the surface layer is very dark grayish brown, mottled, friable silt loam about 8 inches thick. The upper substratum is dark brown and dark grayish brown, mottled, friable silt loam. It extends to a depth of about 39 inches. Below this is a buried surface layer of very dark gray, mottled, firm silty clay loam about 12 inches thick. The lower substratum to a depth of 68 inches is dark grayish brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of the very poorly drained Booker soils and small areas of Waldron soils. Both of these soils have more clay than the Dupo soil. Also, they are lower on the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Dupo soil and slow in the lower part. Surface runoff is slow in cultivated areas. The available water capacity is high. Natural fertility also is high, and the organic matter content is moderately low. The seasonal high water table is at a depth of 1.5 to 3.5 feet during most winter and spring months. The shrink-swell potential is low in the upper part of the profile and high in the lower part. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content, but it tends to puddle or crust after hard rains.

Nearly all areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Wetness is the main problem. Land grading can improve surface drainage. Returning crop residue to the soil helps to maintain fertility and tilth.

This soil is well suited to the commonly grown legumes, such as red clover and lespedeza; cool-season grasses, such as reed canarygrass; and warm-season grasses, such as switchgrass. Wetness is the main problem. Plants should be selected accordingly. A seedbed can be easily prepared. A drainage system is beneficial, especially if deep-rooted species are grown. Overgrazing and grazing when the soil is too wet should be avoided.

This soil generally is not used for building site development or onsite waste disposal because of the flooding.

The land capability classification is IIw. No woodland ordination symbol is assigned.

45C—Freeburg silt loam, 3 to 9 percent slopes. This deep, gently sloping and moderately sloping, somewhat poorly drained soil is on low stream terraces. It is subject to rare flooding. In most areas slopes are short and steep along the escarpments of the terraces. Individual areas are irregular in shape and range from 5 to 25 acres in size.

Typically, the surface layer is mixed very dark grayish brown and dark brown, friable silt loam about 5 inches thick. The subsoil is mottled, firm silty clay loam about 28 inches thick. The upper part is brown, and the lower part is grayish brown. The substratum to a depth of 60 inches or more is grayish brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Moniteau soils. These soils are grayer than the Freeburg soil. They make up about 10 percent of the unit.

Permeability is moderately slow in the Freeburg soil. Surface runoff is slow or medium in cultivated areas. The available water capacity is high. Natural fertility is medium, and the organic matter content is moderately low. A perched water table is at a depth of 1.5 to 3.0 feet during most winter and spring months. The shrink-swell potential is moderate. The surface layer is very friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas are used for row crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Diversion terraces can protect some areas against runoff from the adjacent uplands.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to the commonly grown legumes, such as red clover, ladino clover, and lespedeza; cool-season grasses, such as reed canarygrass; and warm-season grasses, such as switchgrass. The perched water table is the main problem. Plants should be selected accordingly. A seedbed can be easily prepared. A drainage system is beneficial, especially if deep-rooted species are grown.

A few small areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil generally is not used for building site development or onsite waste disposal because of the flooding.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

49D—Armster cobbly loam, 5 to 14 percent slopes. This deep, moderately sloping and strongly sloping, moderately well drained soil is on convex ridgetops and side slopes in the uplands. Stones are on the surface throughout the unit. They are 60 to 100 feet apart. Individual areas are broad and irregular in shape and range from 100 to several hundred acres in size.

Typically, the surface layer is black, friable cobbly loam about 9 inches thick. The subsoil extends to a depth of about 58 inches. The upper part is mixed brown and red, mottled, friable clay loam; the next part is dark yellowish brown and yellowish brown, mottled, firm clay loam; and the lower part is mottled light gray, brownish yellow, and yellowish brown, firm clay loam. The substratum to a depth of 72 inches or more is mottled light gray and yellowish brown, firm clay loam. In places the surface layer is dark grayish brown. In severely eroded areas it is brown clay loam.

Included with this soil in mapping are small areas of Lindley soils. These soils have a light colored surface layer. They are well drained and are lower on the landscape than the Armster soil. They make up 10 to 15 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is medium or rapid. The available water capacity is moderate. Natural fertility is medium, and the organic matter content is moderately low. A perched water table is at a depth of 3 to 5 feet during most winter and spring months. The shrink-swell potential is high.

Most areas are used for pasture, hay, or timber. Very few areas are used for cultivated crops because of the potential damage to tillage equipment caused by cobbles and stones on the surface. This soil is suited to cultivated crops only if the crops are grown on a limited basis in rotation with close-grown pasture and hay crops. If row crops are grown, erosion is a severe hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface can help to control erosion.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; cool-season grasses, such as smooth brome and orchardgrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

Many areas support stands of native hardwoods, dominantly black oak, northern red oak, and white oak. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suitable for building site development. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Some land shaping may be necessary. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil generally is unsuitable as a site for conventional septic tank absorption fields because of the restricted permeability. Sewage lagoons can function adequately if the site is leveled, the stones are removed, and the berms and bottom of the lagoon are sealed with slowly permeable material, which helps to prevent the contamination of ground water. Also, waste can be piped to the adjacent areas that are suitable for sewage lagoons.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, and frost action are limitations. Some cutting and filling may be necessary because of the slope. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IVe. The woodland ordination symbol is 4A.

49F—Armster cobbly loam, 14 to 30 percent slopes. This deep, moderately steep and steep, moderately well drained soil is on convex side slopes in the uplands. Stones are on the surface throughout the unit. They are 60 to 100 feet apart. Individual areas are irregular in shape and range from 10 to 150 acres in size.

Typically, the surface layer is very dark grayish brown, friable cobbly loam about 5 inches thick. The subsurface layer is very dark grayish brown, mottled, friable loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. In sequence downward, it is red, firm clay loam; mixed yellowish brown and red, firm clay; mottled light brownish gray, pale brown, red, and strong brown, firm clay loam; strong brown, mottled, firm clay loam and sandy clay loam; and brownish yellow, mottled, firm clay loam. In some severely eroded areas, the surface layer is brown clay loam.

Included with this soil in mapping are small areas of Lindley soils. These soils are well drained and are lower on the landscape than the Armster soil. They have a light colored surface layer. They make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is rapid. The available water capacity is moderate. Natural fertility is medium, and the organic matter content is moderately low. A perched water table is at a depth of 3 to 5 feet during most winter and spring months. The shrink-swell potential is high.

Most areas are used for pasture, hay, or timber. This soil is not suited to cultivated crops because of a severe hazard of erosion.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management concerns. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Many areas support stands of native hardwoods, dominantly black oak, northern red oak, and white oak. This soil is suited to trees. The hazard of erosion, the equipment limitation, and seedling mortality are management concerns. Carefully designing logging roads and skid trails can minimize the steepness and length of slopes and the concentration of water. Seeding of disturbed areas may be necessary after harvesting is completed. Operating equipment is hazardous because of the slope. The roads and skid trails should be built on the contour. In the steepest areas the logs should be yarded uphill to the logging roads and skid trails. Hand planting or direct seeding may be needed. Planting container-grown nursery stock increases the seedling survival rate.

This soil generally is not used for onsite waste disposal or building site development because of the slope.

The land capability classification is VIe. The woodland ordination symbol is 4R.

56B—Weller silt loam, 2 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on ridgetops and the upper side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 90 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 3 inches thick. The subsurface layer is brown, friable silt loam about 3 inches thick. The subsoil is about 47 inches thick. The upper part is yellowish brown, mottled, friable silt loam. The next part is yellowish brown, mottled, firm silty clay loam and silty clay. The lower part is light brownish gray and grayish brown, mottled, firm silty clay loam. The substratum to a depth of 60 inches or more is light brownish gray, mottled, firm silt loam.

Included with this soil in mapping are a few scattered small areas of Winfield soils. These soils have less clay than the Weller soil. They make up about 10 percent of the unit.

Permeability is slow in the Weller soil. Surface runoff is medium in cultivated areas. The available water capacity is high. Natural fertility is medium, and the organic matter content is moderately low. A perched water table is at a depth of 2 to 4 feet during most winter and spring months. The shrink-swell potential is high.

Most areas are used for cultivated crops or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, a combination of terraces and grassed waterways or tile outlets, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. In places a grade stabilization structure is needed in conjunction with grassed waterways. Properly managing crop residue helps to control erosion, maintain the content of organic matter, and increase the rate of water intake.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development if proper design and installation procedures are used. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations helps to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil generally is not used as a site for septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

56C2—Weller silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on the upper side slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 10 to 240 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil to a depth of 60 inches or more is mottled, firm silty clay loam and silty clay. The upper part is yellowish brown, and the lower part is light brownish gray.

Included with this soil in mapping are a few scattered small areas of Winfield soils. These soils have less clay than the Weller soil. They make up about 10 percent of the unit.

Permeability is slow in the Weller soil. Surface runoff is medium in cultivated areas. The available water capacity is high. Natural fertility is medium, and the organic matter content is moderately low. A perched water table is at a depth of 2 to 4 feet during most winter and spring months. The shrink-swell potential is high.

Most areas are used for cultivated crops or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Properly managing crop residue helps to control erosion, maintain the content of organic matter, and increase the rate of water intake.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development if proper design and installation procedures are used. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations helps to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil generally is not used as a site for septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

56D2—Weller silt loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, moderately well drained soil is on side slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 10 to 70 acres in size.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil to a depth of 60 inches or more is mottled, firm silty clay loam and silty clay. The upper part is yellowish brown, and the lower part is light brownish gray.

Included with this soil in mapping are a few scattered small areas of Winfield soils. These soils have less clay than the Weller soil. They make up about 10 percent of the unit.

Permeability is slow in the Weller soil. Surface runoff is rapid in cultivated areas. The available water capacity is high. Natural fertility is medium, and the organic matter content is moderately low. A perched water table is at a depth of 2 to 4 feet during most winter and spring months. The shrink-swell potential is high.

Most areas are used for cultivated crops or pasture. This soil is suited to cultivated crops grown on a limited basis in rotation with pasture and hay crops. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Properly managing crop residue helps to control erosion, maintain the content of organic matter, and increase the rate of water intake.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development if proper design and installation procedures are used. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations helps to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil generally is not used as a site for septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, frost action, and the wetness are the main limitations. Some cutting and filling may be necessary because of the slope. Also, the roads can be designed so that they conform to the natural slope of the land. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IVe. The woodland ordination symbol is 3C.

60D2—Weingarten silt loam, 5 to 14 percent slopes, eroded. This deep, moderately sloping and strongly sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are long and irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark brown, friable silt loam about 6 inches thick. The subsoil to a depth of 65 inches or more is mottled, firm silty clay loam. The upper part is yellowish brown and brown, the next part is brown and partly brittle, and the lower part is reddish brown. In some places the lower part of the subsoil has less clay and is not so red. In other places the upper part of the subsoil has more clay and is mottled.

Included with this soil in mapping are small areas of Gasconade, Goss, and Weller soils. Gasconade and Goss soils are steeper than the Weingarten soil. The shallow Gasconade soils are in areas intermingled with outcrops of limestone bedrock below the Weingarten soil. The cherty Goss soils are on the lower side slopes. Weller soils have more clay than the Weingarten soil. They are moderately well drained and are in landscape positions similar to those of the Weingarten soil. Included soils make up about 5 percent of the unit.

Permeability is moderately slow in the Weingarten soil. Surface runoff is medium or rapid in cultivated areas. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. Root development is moderately restricted at a depth of about 40 to 60 inches.

Most areas are used for pasture, hay, or timber. This soil is suited to row crops grown on a limited basis in rotation with close-grown pasture and hay crops. If row crops are grown, erosion is a severe hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and conservation cropping systems that include grasses and legumes can help to control erosion. In some areas slopes are long enough and smooth enough for terraces, grassed waterways, and contour farming. In these areas a grade stabilization structure is needed. Properly managing crop residue helps to control erosion, maintain tilth, increase or maintain the content of organic matter, and increase the rate of water intake.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to tall fescue, switchgrass, and red clover. It is moderately well suited to orchardgrass, smooth brome, big bluestem, little bluestem, and alfalfa. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary. Fertility can be maintained by applications of lime and fertilizer. Mowing is needed to control brush and weeds.

Many areas support stands of native hardwoods, dominantly northern red oak, white oak, and black oak. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suitable for building site development if proper design and installation procedures are used. Foundations, footings, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

Sewage lagoons can function adequately if the site is leveled. The berms and bottom of the lagoons should be sealed with slowly permeable material, which helps to prevent seepage.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, and frost action are the main limitations. Some cutting and filling may be necessary because of the slope. Also, the roads can be designed so that they conform to the natural slope of the land. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IVe. The woodland ordination symbol is 4A.

64F—Lily-Winfield-Rock outcrop complex, 5 to 35 percent slopes. This map unit occurs as areas of a moderately deep, moderately sloping to steep, well drained Lily soil; a deep, moderately sloping to steep, moderately well drained Winfield soil; and Rock outcrop. The unit is on ridgetops and side slopes in the uplands. Most areas are dissected by deep drainageways. The Lily soil is on the middle part of the ridgetops and the upper side slopes. The Winfield soil is in the saddles between sandstone domes and on the domes. Individual areas range from 25 to 165 acres in size. They are about 45 percent Lily soil, 25 percent Winfield soil, and 10 percent Rock outcrop. The two soils and the Rock outcrop occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the surface layer of the Lily soil is dark brown, friable loam about 6 inches thick. The subsoil is about 23 inches thick. It is dark brown, mottled, and friable. The upper part is clay loam, and the lower part is sandy clay loam. The substratum is dark brown, mottled, friable sandy clay loam about 3 inches thick. Hard sandstone bedrock is at a depth of about 32 inches.

Typically, the surface layer of the Winfield soil is brown, friable silt loam about 5 inches thick. The subsoil is silty clay loam about 32 inches thick. The upper part is dark yellowish brown and friable, and the lower part is dark yellowish brown and yellowish brown, mottled, and firm. The substratum to a depth of 60 inches or more is yellowish brown, mottled, friable silt loam.

Included in this unit in mapping are small areas of Gasconade, Gosport, and Goss soils. The shallow Gasconade soils have more clay than the Lily soil. They are on the lower side slopes, in areas intermingled with outcrops of limestone bedrock. Gosport soils are moderately deep over bedded shale. They are in landscape positions similar to those of the Lily soil. The deep, cherty Goss soils are on the lower side slopes. Also included are soils that are shallow over sandstone bedrock. Included soils make up about 20 percent of the unit.

Permeability is moderately rapid in the Lily soil and moderate in the Winfield soil. Surface runoff is rapid on both soils. The available water capacity is low in the Lily soil and high in the Winfield soil. A perched water table is at a depth of 2.5 to 4.0 feet during most winter and spring months in the Winfield soil. The shrink-swell potential is low in the Lily soil and moderate in the Winfield soil. Natural fertility is low in both soils, and the organic matter content is moderately low.

Most areas support native hardwoods. Some areas are partly covered by shrubs and grasses. The Lily and Winfield soils generally are unsuitable for cultivation because of the low available water capacity in the Winfield soil and a severe hazard of erosion on both soils. Some small fields are suitable for crops if they are protected from excessive erosion by a system of conservation tillage that leaves a protective cover of crop residue on the surface, contour farming, a crop rotation that includes grasses and legumes, and diversions. Returning crop residue to the soils or regularly applying other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Measures that control runoff can increase the moisture supply.

The Lily soil is well suited to legumes, such as lespedeza and birdsfoot trefoil; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, Caucasian bluestem, and indiangrass. It is moderately suited to most other legumes and cool-season grasses. Shallow-rooted species that can tolerate droughtiness should be selected for planting. The Winfield soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management concerns on both soils. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth for good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Many areas support native hardwoods, dominantly good-quality white oak. The Lily and Winfield soils are suited to trees. The hazard of erosion, the equipment limitation, and seedling mortality are the main management concerns. Constructing logging roads and skid trails on the contour minimizes the steepness and length of slopes. Seeding of disturbed areas may be necessary after harvesting. The logs should be yarded uphill to the logging roads or skid trails. Planting container-grown nursery stock increases the seedling survival rate.

The Lily soil generally is not used for building site development or onsite waste disposal because of the slope and the depth to bedrock. The Winfield soil is suitable as a site for buildings and sewage lagoons if proper design and installation procedures are used. Dwellings can be designed so that they conform to the natural slope of the land. Land shaping is necessary in some areas. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations help to prevent the damage caused by excessive wetness. Sewage lagoons can function adequately on the Winfield soil if the site is leveled and if the bottom and berms of the lagoons are sealed.

The Lily and Winfield soils generally are suited to local roads and streets. The slope, the depth to bedrock, low strength, the shrink-swell potential, and frost action are limitations. Some cutting and filling may be necessary because of the slope. Also, the roads can be designed so that they conform to the natural slope of the land. Some blasting may be needed because of the outcrops of bedrock. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is VIe. The woodland ordination symbol is 3R.

73F—Gosport silt loam, 5 to 30 percent slopes. This moderately deep, moderately sloping to steep, moderately well drained soil is on convex side slopes in the uplands. Individual areas are irregular in shape and range from about 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 5 inches thick. The subsoil is about 28 inches thick. In sequence downward, it is mixed brown and yellowish brown, friable silt loam; yellowish brown, mottled, firm silty clay; mottled light brownish gray, yellowish red, and yellowish brown, firm silty clay; and yellowish brown, mottled, firm silty clay. Light olive gray, soft, weathered shale bedrock is at a depth of about 33 inches.

Included with this soil in mapping are small areas of Gasconade, Goss, and Snead soils. Gasconade and Goss soils are on side slopes below the Gosport soil. Gasconade soils have a dark surface layer, are shallow over bedrock, and are in areas intermingled with outcrops of bedrock. Goss soils are deep and cherty throughout. Snead soils have a dark surface layer. They are in landscape positions similar to those of the Gosport soil. Also included are areas where the shale bedrock is hard and brittle. Included soils make up about 15 percent of the unit.

Permeability is very slow in the Gosport soil. Surface runoff is rapid. The available water capacity is moderate. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is high.

Most areas are used for woodland, pasture, or hay. The suitability for hay can be restricted by the slope. This soil is well suited to legumes, such as lespedeza and birdsfoot trefoil; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem and indiangrass. It is moderately suited to most other legumes and cool-season grasses. Shallow-rooted species that can tolerate droughtiness should be selected for planting. Erosion during seedbed preparation is a serious hazard. Timely tillage and a quickly established ground cover help to prevent excessive soil loss. Overgrazing reduces yields and increases the extent of weeds.

This soil is suited to trees. The hazard of erosion, the equipment limitation, seedling mortality, and windthrow are management concerns. Properly designing and constructing logging roads, skid trails, and fire lanes can minimize the steepness and length of slopes and thus reduce the hazard of erosion. Reseeding of disturbed areas may be necessary after harvesting. In the steepest areas the logs should be yarded uphill to the logging roads and skid trails. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suited to building site development if proper design and installation procedures are used. It is better suited to dwellings without basements than to dwellings with basements. The dwellings should be designed so that they conform to the natural slope of the land. Some blasting may be necessary because of the depth to bedrock. Footings, foundations, and basement walls should be constructed with reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by frost action and by shrinking and swelling.

This soil generally is not suited to onsite waste disposal because of the slope and the depth to bedrock. Sewage generally can be piped to the adjacent areas where the soils are suitable for onsite waste disposal.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, and frost action are limitations. Some cutting and filling may be necessary because of the slope. Also, the roads can be designed so that they conform to the natural slope of the land. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is VIIe. The woodland ordination symbol is 2R.

74D2—Snead silty clay loam, 9 to 14 percent slopes, eroded. This moderately deep, strongly sloping, moderately well drained soil is on convex side slopes along drainageways in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is black, friable silty clay loam about 5 inches thick. The subsurface layer is black, firm silty clay loam about 5 inches thick. The subsoil is firm silty clay about 14 inches thick. The upper part is black and mottled, and the lower part is mottled very dark gray, yellowish brown, strong brown, and dark grayish brown. Soft, weathered shale bedrock is at a depth of about 24 inches.

Included with this soil in mapping are small areas of Gasconade, Gosport, and Goss soils. The shallow Gasconade soils and the deep, cherty Goss soils are in areas intermingled with rock outcrops on the lower side slopes. Gosport soils have a light colored surface layer. They are in landscape positions similar to those of the Snead soil. Also included are areas where the shale bedrock is hard and brittle. Included areas make up 10 to 15 percent of the unit.

Permeability is slow in the Snead soil. Surface runoff is rapid. The available water capacity is low. Natural fertility is medium, and the organic matter content is moderate. A perched water table is at a depth of 2 to 3 feet during most winter and spring months. The shrink-swell potential is high. The surface layer is friable, but it can be tilled only within a narrow range in moisture content. If tilled when wet or dry, it becomes cloddy. Also, it becomes compacted if tilled when wet.

Most areas are used for pasture or hay. Some small areas are used for cultivated crops along with the surrounding areas. A few areas are used as woodland. This soil is not suited to cultivated crops but can be occasionally used for small grain when pasture and hay crops are becoming established. If row crops are grown, erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves protective amounts of crop residue on the surface. Regularly adding organic material improves fertility, helps to prevent surface compaction, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. This soil is moderately well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. Erosion is the main problem. A good ground cover is necessary at all times if forage production is to be maintained. Nurse crops help to prevent excessive soil loss in newly seeded areas. Timely tillage is needed. Also, the soil should be tilled on the contour. No-till seeding methods help to protect the surface. Overgrazing should be avoided.

A few areas support native hardwoods. This soil is suited to trees. Seedling mortality and windthrow are the main management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable to building site development if proper design and installation procedures are used. It is unsuitable as a site for conventional septic tank absorption fields. All sanitary facilities should be connected to commercial sewers. Otherwise, sewage generally can be piped to the adjacent areas that are suitable for onsite waste disposal. The moderate depth to bedrock also is a limitation on sites for dwellings with basements, but the bedrock is soft and can be excavated. Dwellings without basements can be designed so that they conform to the natural slope of the land. Some cutting and filling may be needed. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations helps to prevent the damage caused by excessive wetness.

This soil is suited to local roads and streets. The slope, low strength, the shrink-swell potential, frost action, and the wetness are the main limitations. Some cutting and filling may be necessary because of the slope. Also, the roads can be designed so that they conform to the natural slope of the land. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is Vle. The woodland ordination symbol is 3D.

80C—Winfield silt loam, bench, 3 to 9 percent slopes. This deep, gently sloping and moderately sloping, moderately well drained soil is on benches along the major tributary streams. Individual areas range from 10 to 120 acres in size.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsurface layer also is brown, friable silt loam. It is about 6 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is brown and dark yellowish brown, friable silty clay loam; the next part is dark yellowish brown, firm silty clay loam; and the lower part is dark yellowish brown, mottled, firm silty clay loam.

Included with this soil in mapping are small areas of Gasconade, Goss, and Weller soils. The shallow Gasconade soils and the cherty Goss soils are in areas intermingled outcrops of bedrock on the lower side slopes. Weller soils have more clay than the Winfield soil and are grayer. They are in landscape positions similar to those of the Winfield soil. Also included are short, steep escarpments along the perimeter of the mapped areas. Included areas make up about 10 percent of the unit.

Permeability is moderate in the Winfield soil. Surface runoff is slow or medium in cultivated areas. The available water capacity is high. Natural fertility is low, and the organic matter content is moderately low. A perched water table is at a depth of 2.5 to 4.0 feet during most winter and spring months. The shrink-swell potential is moderate. The surface layer is friable, but it tends to crust after heavy rains where it is mixed with the subsoil.

Most areas are used for row crops or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Properly managing crop residue helps to control erosion, maintain tilth, increase or maintain the content of organic matter, and increase the rate of water intake.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and red clover; cool-season grasses, such as tall fescue and timothy; and warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management concerns. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are necessary.

Some areas support native hardwoods, dominantly white oak of good quality. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suitable for building site development if proper design and installation procedures are used. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Sites for small commercial buildings should be graded. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

This soil generally is not used as a site for septic tank absorption fields because of the restricted permeability and the wetness. It can be used for sewage lagoons if the site is leveled. Seepage from the lagoons can be controlled by sealing the bottom and berms with slowly permeable material.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, and frost action are the main limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

83C—Weller silt loam, bench, 3 to 9 percent slopes. This deep, gently sloping and moderately sloping, moderately well drained soil is on benches along the major tributary streams. Individual areas range from 10 to 135 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsurface layer is mixed brown and yellowish brown, friable silt loam about 4 inches thick. The subsoil to a depth of 60 inches or more is firm silty clay loam. The upper part is brown and dark yellowish brown; the next part is dark yellowish brown and mottled; and the lower part is mottled light brownish gray, yellowish brown, dark yellowish brown, and pale brown.

Included with this soil in mapping are small areas of Gasconade, Goss, and Winfield soils. The shallow Gasconade soils and the cherty Goss soils are in areas intermingled with outcrops of bedrock on the lower side slopes. Winfield soils have less clay than the Weller soil and are browner. They are in landscape positions similar to those of the Weller soil. Also included are the short, steep escarpments along the perimeter of the mapped areas. Included areas make up about 10 percent of the unit.

Permeability is slow in the Weller soil. Surface runoff is slow or medium in cultivated areas. The available water capacity is high. Natural fertility is medium, and the organic matter content is moderately low. A perched water table is at a depth of 2 to 4 feet during most winter and spring months. The shrink-swell potential is high. The surface layer is friable, but it tends to crust after heavy rains where it is mixed with the subsoil.

Most areas are used for row crops or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a severe hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, a combination of terraces and grassed waterways or tile outlets, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Some type of grade stabilization structure generally is needed in conjunction with grassed waterways. Properly managing crop residue helps to control erosion, maintain tilth, increase or maintain the content of organic matter, and increase the rate of water intake.

A cover of pasture plants or hay is very effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as ladino clover and lespedeza; cool-season grasses, such as tall fescue and reed canarygrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. The species that can tolerate wetness grow best. Erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

Some areas support native hardwoods, dominantly white oak of good quality. This soil is suited to trees. No major hazards or limitations affect planting or harvesting. Measures that improve the stands are needed.

This soil is suitable for building site development if proper design and installation procedures are used. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile around the footings and foundations helps to prevent the damage caused by excessive wetness. Adequately reinforced concrete, expansion joints, and a sand or gravel base can minimize the damage to sidewalks and driveways caused by shrinking and swelling and by frost action.

Septic tank absorption fields generally cannot function adequately on this soil because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled. Seepage from the lagoons can be controlled by sealing the bottom and berms with slowly permeable material.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are the main limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling, frost action, and wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

87B—Wiota silt loam, 2 to 5 percent slopes. This deep, gently sloping, well drained soil is on low stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from about 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 11 inches thick. The subsurface layer also is very dark grayish brown, friable silt loam. It is about 7 inches thick. The subsoil is dark brown, firm silty clay loam about 28 inches thick. The substratum to a depth of 60 inches or more is dark brown, mottled, firm silt loam.

Included with this soil in mapping are small areas of Menfro and Winfield soils. These soils are steeper than the Wiota soil and are on uplands. They have a light colored surface layer. They make up about 10 percent of the unit.

Permeability is moderate in the Wiota soil. Surface runoff is medium in cultivated areas. The available water capacity is high. Natural fertility also is high, and the organic matter content is moderate. The shrink-swell potential also is moderate. The surface layer is friable and can be easily tilled. Root development is not restricted.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, a combination of terraces and grassed waterways or tile outlets, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; cool-season grasses, such as smooth brome and orchardgrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suitable for building site development if the structures are properly designed and are constructed above known flood levels or on raised, well compacted fill. Onsite investigation and knowledge of the flooding history of the area are necessary when suitable building sites are selected. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete, which helps to prevent the structural damage caused by shrinking and swelling.

Sewage lagoons can function adequately if the site is leveled and the bottom and berms of the lagoons are sealed with slowly permeable material, which helps to prevent seepage.

This soil is suited to local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material or mixing the soil with additives can help to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

98F—Bethesda-Dumps complex, 5 to 60 percent slopes. This map unit consists of a deep, moderately sloping to steep, well drained Bethesda soil intermingled with areas of mine dumps. The unit is in the uplands. The mine spoil consists of the original topsoil, subsoil, shale, coal, glacial till, limestone, and chert fragments in areas surface mined for coal and fireclay. The unit is made up of about equally extensive areas of the Bethesda soil and mine dumps. Individual areas are irregular in shape and range from 5 to 1,000 acres in size.

Typically, the surface layer of the Bethesda soil is variegated light brownish gray, light olive brown, and dark yellowish brown, friable shaly silty clay loam. The substratum extends to a depth of 60 inches or more. In sequence downward, it is variegated light brownish gray and yellowish brown, friable very shaly silty clay loam; grayish brown, firm very shaly silty clay loam;

variegated light brownish gray, brownish yellow, and reddish brown, friable very shaly silty clay loam; and light olive gray, mottled, friable very shaly silty clay loam. In some places the substratum is medium acid or slightly acid. In other places it contains more clay.

Dumps consist of large piles of mixed overburden derived from mining activities. They are devoid of vegetation.

Included in this unit in mapping are long, narrow areas of mostly acidic water. These areas are the abandoned pits in the mines. They make up about 10 percent of the unit.

Permeability is moderately slow in the Bethesda soil. Surface runoff is very rapid. The available water capacity is moderate. Natural fertility is low, and the organic matter content is very low.

Most areas support no vegetation. The vegetated areas generally support poor-quality timber and shrubs.

The slope and the exposed acidic substratum are the main limitations affecting land uses. Vegetation generally cannot grow on this unit. Small areas of the Bethesda soil can be reclaimed to an adequate plant cover with a minimum investment. As the size of the mine and the intensity of mining activities increase, the difficulty of reclamation and the investment required also increase.

Before the Bethesda soil is planted to timber or pasture species, some leveling and shaping are needed. The hazard of erosion, the equipment limitation, seedling mortality, and windthrow are concerns in managing woodland. Carefully designing logging roads and skid trails can minimize the steepness and length of slopes and the concentration of water. Seeding of disturbed areas may be necessary after harvesting is completed. Planting container-grown nursery stock increases the seedling survival rate. Hand planting or direct seeding may be needed. Operating equipment is hazardous because of the slope. The roads and skid trails should be built on the contour.

In the areas used as pasture, overgrazing or grazing when the soil is wet results in compaction, excessive runoff, and poor tilth. Some of the water-filled pits can be used as a source of livestock water.

The Bethesda soil is unsuitable for cultivated crops and building site development because of the slope. Some of the pits can be used as sites for sanitary landfills.

The land capability classification is VIIe. No woodland ordination symbol is assigned.

99—Pits, quarries. This map unit occurs as open excavations from which limestone or dolomite has been quarried or is now being quarried, nearly level to steep piles of waste rock and soil material, stockpiles of marketable lime and crushed rock, equipment areas, and transport roads. The unit is in the uplands. Individual areas range from about 15 to 120 acres in size.

Typically, each side of the pits has a vertical face or exposure of limestone or dolomite rock. These exposures extend from the bottom of the pits to a height of about 10 to 50 feet. Above this vertical rock face are layers of glacial material 1 to 10 feet thick. In some areas 3 to 10 feet of loess overlies the vertical rock. The overburden is removed and stockpiled in the adjoining undisturbed areas or placed in previously mined pits. Buildings, roads, and other structures and works used in processing the rock or in manufacturing the lime cover much of the surface.

A few small areas support vegetation, primarily small hardwoods, annual weeds, and perennial grasses.

The active quarry pits are dry, but most of the abandoned ones contain water. The pits vary greatly in composition. Identification of the soils in areas of this unit is not practical. Detailed onsite investigation is needed to determine the suitable uses of these areas.

This map unit is not assigned a land capability classification or a woodland ordination symbol.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 164,450 acres in Callaway County, or 30 percent of the total acreage, is prime farmland. About 67 percent of the prime farmland is in the prairie region in the northern part of the county. Calwoods, Mexico, and Putnam soils are the dominant soils in this region. About 15 percent of the prime farmland is in the southernmost part of the county, on the flood plains along the Missouri River. The rest of the prime farmland is in scattered areas throughout the county. Most of the prime farmland is used for crops.

The map units in the county that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not a specific area of the soils is adequately drained or is frequently flooded during the growing season. Most areas of the naturally wet soils in the county are adequately drained because of the application of drainage measures or the incidental drainage that results from farming, road building, or other kinds of land development.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the county. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the county. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the county, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Approximately 284,000 acres in Callaway County, or 52 percent of the total acreage, was used for crops and pasture in 1967 *(9)*. Of this total, about 85,000 acres was used as permanent pasture; 99,000 acres for cultivated crops, mainly corn, soybeans, sorghum, and wheat; and 67,000 acres for rotation hay and pasture. About 33,000 acres was used mainly for conservation purposes or for hay. In 1983, about 98,000 acres was used for cultivated crops *(10)*. Loss of cropland to highway construction and urban development has been slight. Because of fluctuations in the livestock market, the acreage used as permanent pasture decreased and the acreage used for hay increased in the 1970's.

The potential of the soils in Callaway County for sustained production of food is good. About 164,450 acres in the county is prime farmland. Adequate conservation practices are used on only about 30 percent of cropland and pasture *(9)*. Conservation practices are inadequate in most of the cropped areas on uplands. These areas are farmed in a manner that causes excessive erosion and thus prevents sustained crop production over a long period. Converting some of the marginal cropland used for row crops to pasture or hayland can help to control erosion. On most of the cropland in the county, a system of conservation practices designed for specific sites can help to keep erosion within tolerable limits.

Water erosion is the major problem on nearly all of the sloping cropland and overgrazed pasture in Callaway County. All of the soils that have slopes of more than 2 percent are susceptible to erosion. Armster, Armstrong, Calwoods, Crider, Freeburg, Gasconade, Gorin, Gosport, Goss, Hatton, Keswick, Lily, Lindley, Menfro, Mexico, Snead, Weingarten, Weller, Winfield, and Wiota soils have slopes of more than 2 percent.

Loss of the surface layer through erosion results in reduced productivity. It is especially damaging on soils that have a clayey subsoil, which is incorporated into the plow layer when the soils are cultivated. Armster, Armstrong, Calwoods, Gorin, Gosport, Hatton, Keswick, Mexico, Snead, and Weller soils have a clayey subsoil. In clayey spots on many fields, seedbed preparation and tillage are difficult because the original friable surface soil has been eroded away. In eroded areas, tilth is poor and the surface puddles and crusts during periods of heavy rainfall. Erosion also reduces the productivity of soils that tend to be droughty and are shallow over bedrock, such as Gasconade soils.

Erosion on farmland results in the sedimentation of streams, lakes, and ponds. Controlling erosion minimizes this pollution and improves the quality of water for municipal use, for recreation, and for fish and wildlife. It also prolongs the useful life of ponds and lakes.

Erosion-control practices provide a protective cover, help to control runoff, and increase the rate of water infiltration. A cropping system that keeps a cover of plants or crop residue on the surface helps to hold soil losses to amounts that will not reduce the productive capacity of the soils. Contour stripcropping helps to control erosion by maintaining a permanent cover of grasses or of grasses and legumes in contoured strips. The strips are generally used for hay, and the areas between the strips are used for row crops, which are planted on the contour. Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Including such legumes as clover and alfalfa in the crop rotation improves tilth and provides nitrogen for the following crop. No-till planting, which is becoming more common in the county, is effective in controlling erosion on sloping soils. It can be used on many soils in the county, although severely eroded soils require special management.

Terraces reduce the length of slopes and thus help to control runoff and erosion. Conventional terraces are most practical on uneroded upland soils that have long, smooth slopes of less than 8 percent. Special construction and management techniques are needed if terrace systems are to be effective in most areas of the strongly sloping Armster, Armstrong, Crider, Keswick, Menfro, Snead, Weingarten, Weller, and Winfield soils. Soil loss is severe if the moderately steep Armster, Menfro, and Winfield soils are used for row crops. Terraces that have grassed back slopes reduce the gradient of slopes, but conventional terraces increase the gradient, thus increasing the need for further erosion-control measures.

On strongly sloping soils, a cropping system that provides a substantial vegetative cover or a system of conservation tillage that leaves a large amount of crop residue on the surface is needed. Minimizing tillage and leaving a large quantity of crop residue on the surface increase the rate of water infiltration, reduce the runoff rate, and help to control erosion. These practices can be applied on many of the soils in the county, but they are less successful on eroded soils that have a clayey surface layer. In some areas of Armster, Armstrong, Keswick, Mexico, and Snead soils, special management is required if terracing has exposed the clayey subsoil.

Soil blowing is a hazard in unprotected areas of the sandy Grable and Hodge soils. It not only causes soil loss but also damages young plants. It can be controlled by winter cover crops, conservation tillage, and field windbreaks.

Soil drainage is a management concern on about one-third of the cropland in Callaway County. Some soils are naturally wet because of their position on the landscape, slow permeability, or both. Surface drainage is insufficient on Putnam soils in the uplands. Soils on the flood plains along the Missouri River, such as the clayey Booker or Waldron soils, receive runoff or overflow. When these slowly permeable or very slowly permeable soils receive excess water, they are ponded for long periods. Auxvasse, Belknap, Leta, Marion, and Moniteau soils also accumulate water. On most of the soils in the county, field ditches can remove excess water. Land shaping or grading has improved drainage in only a very few areas in the county. Land shaping eliminates potholes and provides a suitable grade for irrigation.

Frequent or occasional flooding is a hazard on the Belknap, Cedargap, Haymond, Landes, and Moniteau soils along the tributaries of the Missouri River. The flooding commonly occurs during the period November through June.

All of the soils in the county require additional plant nutrients for maximum production. Soil fertility is naturally lower in areas where erosion has removed most of the topsoil than in other areas. Most of the soils are naturally acid in the upper part of the root zone and require applications of ground limestone to raise the pH and calcium level sufficiently for optimum crop growth. The soils on the flood plains along the Missouri River are naturally neutral or mildly alkaline in the upper part of the root zone and generally require few or no additions of limestone. On all of the soils in the county, additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the desired level of yields. The Cooperative Extension

Service can help in determining the kinds and amounts of fertilizer and lime to be applied.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous. The tilth of each soil in the county is given in the section "Detailed Soil Map Units."

Most of the uneroded upland soils that are used for crops have a dark surface layer of silt loam or silty clay loam that is moderate in content of organic matter. Generally, tillage and compaction weaken the structure of the soils that have a surface layer of silt loam. A crust forms on the surface during periods of intensive rainfall. The crust is hard when dry. It reduces the rate of water infiltration and increases the runoff rate. Regularly adding crop residue, manure, or other organic material improves soil structure and tilth.

More clay is in the surface layer, tilth is poorer, infiltration is slower, and runoff is more rapid on all of the eroded soils on uplands than on uneroded soils in similar landscape positions. Eroded soils require conservation practices that can control further erosion.

Fall plowing is common in the county. Most upland soils that are used as cropland are sloping and are subject to damaging erosion if they are plowed in the fall.

In areas of Grable and Hodge soils, which have a surface layer of very fine sandy loam or fine sand, a good seedbed can be easily prepared. These soils tend to be droughty, however, and are subject to soil blowing in unprotected areas.

The clayey Booker, Leta, and Waldron soils stay wet until late in spring during many years. If they are plowed when wet, they tend to be cloddy when dry. Because of the cloddiness, preparing a seedbed is difficult. Plowing these nearly level soils in the fall generally results in better tilth and in less erosion.

Some areas in Callaway County are irrigated by center-pivot or rain-gun systems. These systems supply supplemental water during critical periods of crop growth and thus increase yields. Irrigation also makes double-cropping a feasible alternative. Where soybeans are planted directly into wheat stubble, irrigation can supply enough water to ensure germination and crop growth. The wheat stubble helps to protect the soil against erosion.

Soil and water conservation should be considered when an irrigation system is designed. Immediately after irrigation, the saturated topsoil is highly susceptible to erosion, especially if intensive rainfall occurs. Accelerated erosion can reduce natural fertility and cause rapid sedimentation in bodies of water downstream. Approximately 60 percent of the irrigation water in Callaway County is drawn from wells, some of which are on the flood plains along the Missouri River. The rest of the irrigation water is drawn from reservoirs that may at times be supplemented by well water or creeks. Preventing excessive erosion of topsoil also helps to prevent the sedimentation of reservoirs that supply water for irrigation.

Careful maintenance of terraces is a management concern in irrigated areas. Rutting in areas where the wheels of the irrigation equipment pass over the saturated berm of the terrace reduces the effectiveness of the terrace.

Soybeans and grain sorghum are the field crops best suited to the soils and climate in the county. Also, they are the most commonly grown crops. In 1983, the two crops were grown on about 68,600 acres. Corn was grown on about 9,000 acres. Winter wheat is the most common close-growing crop. It was grown on about 20,400 acres in 1983. Oats and rye also are grown. Grass seed is produced from bromegrass, fescue, and orchardgrass.

Specialty crops are grown on a small acreage in the county. These crops include Jerusalem artichokes, popcorn, sweet corn, white corn, grapes, potatoes, strawberries, sunflowers, tomatoes, and Christmas trees. They require special equipment, management, and propagation techniques.

The pasture and hay crops suited to the soils and climate in the county include several legumes, cool-season grasses, and warm-season native grasses. Alfalfa and red clover are the most common legumes grown for hay. They also are grown with bromegrass, orchardgrass, or timothy for hay and pasture.

The warm-season native grasses suited to the soils and climate in the county are big bluestem, little bluestem, indiangrass, and switchgrass. These grasses grow well during the hot summer months. They can provide good-quality forage during periods when the cool-season plants are dormant in the summer.

The management needed in areas of the warm-season grasses differs from that needed in areas of the cool-season grasses. Prescribed burning may be needed in areas of the warm-season grasses to control undesirable vegetation and to improve the quality and quantity of forage. Burning should not be an annual management practice. It is appropriate only when a specific management objective is to be met. It generally is not necessary more often than once every 3 to 5 years. Fields of warm-season grasses should be separated from fields of cool-season grasses.

Alfalfa grows best on deep, moderately well drained or well drained soils, such as Armster, Crider, Grable, Hatton, Haymond, Keswick, Lindley, Menfro, Weingarten, Weller, Winfield, and Wiota soils. Other legumes and all grasses grow well on most of the soils in the uplands. Water-tolerant species grow well on Auxvasse, Belknap, Booker, Dupo, Leta, Marion, Moniteau, Putnam, and Waldron soils.

The major management concerns in most pastured areas are overgrazing and gully erosion. Controlled grazing results in the survival of desirable plants and maximum forage production. Keeping grasses at a desirable height reduces the runoff rate and helps control gully erosion.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the county, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit *(17)*. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations or hazards that restrict their use.

Class II soils have moderate limitations or hazards that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations or hazards that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations or hazards that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations or hazards that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations or hazards that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations or hazards that nearly preclude their use for commercial crop production. There are no class V or class VIII soils in Callaway County.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, or *s*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w* or *s* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

About 26 percent of the land area in Callaway County is forested *(19)*. Knowledge of soils helps to provide a basic understanding of how forest types develop and tree growth occurs. Some of the relationships between forest types and kinds of soil have been recognized for a long time. White oak grows well on deep, moist soils. Hickory, post oak, and chinkapin oak are more prevalent where the rooting depth is restricted or the moisture supply is limited. The soil serves as a reservoir for moisture, provides an anchor for roots, and supplies most of the available nutrients. Soil properties that directly or indirectly affect these growth requirements include reaction, fertility, drainage, texture, structure, and depth. Landscape position also is important.

Available water capacity is influenced primarily by texture, rooting depth, and content of stones, shale, and chert. Deep soils that have a surface layer of silt loam, such as Menfro soils, have a high available water capacity. The depth to bedrock restricts the amount of available water and root development in Gasconade soils. These limitations reduce the productive potential of the site. Although little can be done to change the limitations, management of the best suited tree species can lessen the effect of the limitations.

The supply of nutrients affects tree growth. In many of the soils on uplands in the county, the subsoil is leached and has a low content of nutrients. In most of the soils on bottom land, the substratum has a higher content of nutrients.

The layer of leaf litter on the surface of the soils is equal in importance to the mineral horizons of the soils. Decomposition of this layer recycles nutrients that have accumulated in the forest ecosystem over long periods. Fire, excessive trampling by livestock, and erosion can result in loss of these nutrients. Measures that prevent wildfires and protect the woodland from overgrazing are needed.

Aspect and position on the landscape affect tree growth. They influence such factors as the amount of available sunlight, air drainage, soil temperature, and moisture relations. Generally, north and east aspects are the best upland sites for trees.

The Mexico-Armstrong association, which is described under the heading "General Soil Map Units," has a very small acreage of forest land. The dominant natural vegetation was prairie grasses. Timber grew in the drainageways and on the Armstrong soils, which supported both prairie vegetation and trees. The species typical of oak-hickory forests were common on these soils.

The Keswick-Lindley-Gorin, Goss-Gasconade, Winfield-Weller, Lindley-Hatton, and Armster, cobbly, associations have significant acreages of forest land. The white oak-red oak-hickory forest type is dominant in areas of these associations. Many other species also grow in these areas. The more common ones are black oak, post oak, chinkapin oak, shingle oak, white ash, sugar maple, elm, black locust, and black walnut. Pure stands of white oak grow on Lindley, Winfield, and Menfro soils on north- and east-facing slopes. Under good management, these soils can produce trees of veneer quality. Menfro soils, which are of minor extent in the Winfield-Weller association, are excellent sites for black walnut.

The rest of the soils in these associations have a moderate potential productivity for woodland. Proper management is important in the production of good-quality timber. Aspect is an important consideration. South and west aspects generally support species of lower quality, such as chinkapin, post oak, hickories, and black oak. The Gasconade soils in the Goss-Gasconade association support eastern redcedar, blue ash, white ash, chinkapin oak, post oak, and elm. They generally cannot support the trees used for commercial wood products.

The soils on bottom land in Callaway County are in the Grable-Waldron-Leta association. Native timber stands remain in naturally wet areas that have not been drained and in unprotected areas. The elm-ash-cottonwood forest type is dominant in these stands. Almost pure stands of cottonwood are common. On the wetter soils, such as on Booker soils, silver maple and black willow are dominant. Many of the soils in this association can be used for pecan trees.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed also are subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

In 1980, a total of 12,517 acres in Callaway County was used for recreational development *(14)*. The ownership of this acreage was about 45 percent state; 51 percent private; 1 percent municipal, federal, school, and county; and 3 percent other. The recreational facilities included hunting lands; camping areas; hiking, horse, and nature trails; athletic fields; game courts; gun and archery ranges; wildlife viewing areas; picnic areas; arenas; and nature areas.

The Cedar Creek Purchase Unit of the Mark Twain National Forest and Reform, Little Dixie, and Whetstone Creek Wildlife Areas, totaling more than 23,000 acres, are the largest public recreational areas in the county. Along with four smaller state and municipal facilities, they provide opportunities for hunting, fishing, swimming, camping, picnicking, hiking, nature study, and wildlife viewing.

In 1974, the county had 16 private and semiprivate commercial recreational enterprises *(13)*. These included campgrounds, pay fishing lakes, a racetrack, a historic site, outdoor theaters, golf courses, riding arenas, and a gun club.

The soils of the county are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation also are important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

Callaway County is one of 21 counties in Missouri that make up the Northeast Riverbreaks Zoogeographic Region *(12)*. The diversity of cover types makes this region one of the richest game areas in the state. As the transition zone between the prairie and the Ozark Border, the region has a variety and profusion of edge growth, which provides excellent wildlife habitat. Some problems affect the wildlife resource in the county. These are a lack of cropland habitat in the four soil associations south of Interstate 70, an increased size of farm fields and the resultant loss of hedgerows and brushy waterways, and fall rather than spring tillage. Fall tillage decreases the amount of food available to wildlife. A mostly tall fescue monoculture in pastured areas and illegal poaching, mainly of turkey, are additional problems.

The Mexico-Armstrong, Grable-Waldron-Leta, and Armster, cobbly, associations, which are described under the heading "General Soil Map Units," make up most of the habitat for openland wildlife in the county. Although mainly wooded, these associations have areas of cropland and grassland. They commonly have scattered small stands of timber, waterways, hedgerows, fence rows, and other areas that provide woody or brushy cover. Such "hard cover" areas provide an important type of habitat that is rapidly disappearing in many of the intensively farmed areas of the state.

Bobwhite quail, one of the most popular game species in the county, is heavily hunted. Quail populations are only fair, however, in nearly all areas, except for those that provide the best habitat. The rabbit population is good. It has attracted a great number of hunters, many of whom come from the St. Louis and St. Charles areas. The resident dove population is good. Interest in hunting this game bird is high. A few ring-necked pheasants are sighted annually in the northern part of the county, but their numbers are too few to support hunting. Songbird populations are excellent throughout the county.

Nearly all of the original prairie areas have been converted to other land uses. The species dependent on this type of habitat have nearly disappeared. A few badgers, prairie chickens, and marsh hawks are all that remain of the numerous prairie birds and animals that once inhabited the county.

The furbearer population in the county is good. Trapping pressure is heavy. Harvest records show that the principal species trapped are raccoon, muskrat, opossum, coyote, beaver, mink, red fox, and gray fox. Coyote hunting by organized groups is very popular in the county.

The Keswick-Lindley-Gorin, Goss-Gasconade, Winfield-Weller, and Lindley-Hatton associations provide most of the woodland wildlife habitat in the county. The other associations have some areas of woodland. About 46 percent of the county provides some form of woodland habitat, which includes areas of the smaller brushy plant species.

The deer population is excellent in the county. The carrying capacity for this animal has not been reached in the northern half of the county. Interest in deer hunting is very high. The deer are hunted not only by county residents but also by urban dwellers from as far away as St. Louis. The turkey population is good and is growing and expanding into additional range. Interest in hunting this game bird is high. The squirrel population is fair or good, but hunting pressure is light. Woodcocks are scarce, and interest in hunting this species is low because the number of woodcocks in migratory flights is small. A fair ruffed grouse population is growing and is expanding into the available habitat. Callaway County is one of only four counties in Missouri having a hunting season for grouse.

Nearly all of wetland habitat in the county is in areas of the Grable-Waldron-Leta association, which is on bottom land. This association is the primary waterfowl area in the county. Though very few permanent marshes remain, the association provides habitat for mallard, teal, wood ducks, and a small resident flock of Canada geese. The county has no large areas where waterfowl concentrate during migratory flights in the fall. The principal waterways providing habitat for wood duck are the Loutre and Middle Rivers and Auxvasse, Cedar, Hillers, and Logan Creeks. Hunting, which is limited, is heaviest along the Missouri River.

Opportunities for fishing are available in the rivers, streams, lakes, and farm ponds. The county has 73 miles of permanently flowing streams *(11)*. The most important of these are the Missouri, Middle, and Loutre Rivers and Cedar, Auxvasse, Logan, and Whetstone

Creeks. These waters are inhabited by largemouth and smallmouth bass, rock bass, catfish, buffalo, suckers, carp, and sunfish. The Missouri River, which borders the county on the south and southwest for 40 miles, is fished commercially for carp, carpsucker, buffalo, sturgeon, paddlefish, and channel, blue, and flathead catfish.

The Little Dixie and McCredie Reservoirs provide opportunities for impoundment fishing. The county has more than 2,500 farm ponds and small lakes, which provide limited opportunities for fishermen to catch bass, bluegill, and channel catfish.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the county are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and the hazard of flooding. Soil temperature and soil moisture also are considerations. Examples of grain and seed crops are corn, wheat, oats, barley, millet, soybeans, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, the hazard of flooding, and slope. Soil temperature and soil moisture also are considerations. Examples of grasses and legumes are bluegrass, tall fescue, switchgrass, orchardgrass, indiangrass, clover, alfalfa, trefoil, and crownvetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and the hazard of flooding. Soil temperature and soil moisture also are considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, pokeweed, foxtail, croton, and partridge pea.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwoods and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, cherry, hawthorn, hickory, blackberry, sassafras, wild plum, sumac, persimmon, Osageorange, and eastern redcedar. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are autumn olive, crabapple, Amur honeysuckle, hawthorn, and hazelnut.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cattail, rushes, sedges, and buttonbush.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, red fox, woodchuck, and mourning dove.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, the shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, the shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. The depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and the shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control water erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the county, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

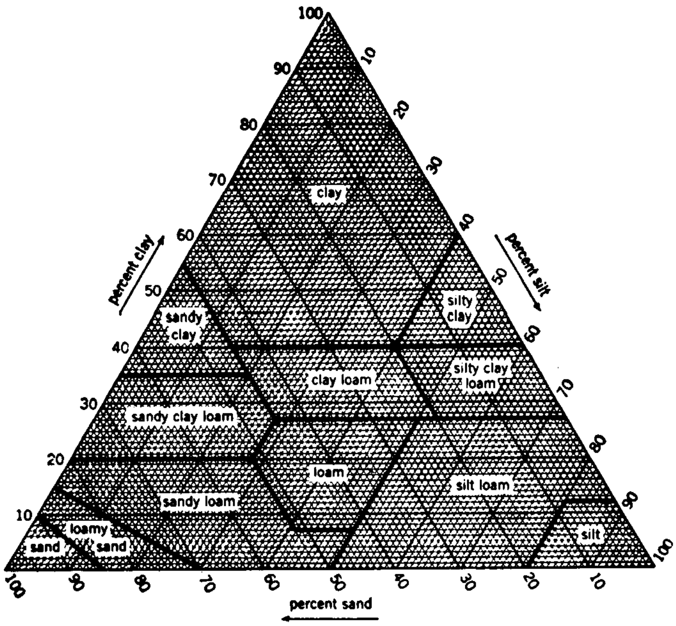

Figure 15.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the county. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 15). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the county and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the county or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the county. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(18)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Fluvaquents (*Fluv*, meaning river, plus *aquent*, the suborder of the Entisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Aeric Fluvaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic (calcareous), mesic Aeric Fluvaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(16)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(18)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Armster Series

The Armster series consists of deep, moderately well drained soils on uplands. These soils formed in a thin layer of loess or pedisediments and in the underlying glacial till. Permeability is moderately slow. Slopes range from 5 to 30 percent.

Typical pedon of Armster loam, 5 to 9 percent slopes, eroded, 1,750 feet west and 1,150 feet north of the southeast corner of sec. 4, T. 49 N., R. 7 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

BE—6 to 9 inches; mixed dark brown (10YR 3/3) and dark yellowish brown (10YR 4/4) clay loam; few fine prominent reddish brown (5YR 4/4) mottles; weak very fine subangular blocky structure; friable; common fine roots; slightly acid; clear smooth boundary.

2Bt1—9 to 14 inches; dark brown (7.5YR 4/4) clay loam; common fine prominent red (2.5YR 4/6) and common fine distinct dark yellowish brown (10YR 4/4) mottles; weak very fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; strongly acid; clear smooth boundary.

2Bt2—14 to 19 inches; dark brown (7.5YR 4/4) clay; common fine prominent red (2.5YR 4/6) and many fine distinct dark yellowish brown (10YR 4/4) mottles; weak very fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; strongly acid; clear smooth boundary.

2Bt3—19 to 26 inches; yellowish brown (10YR 5/4) clay; common fine prominent red (2.5YR 4/6) and common fine distinct grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; few fine glacial pebbles; very strongly acid; clear smooth boundary.

2Bt4—26 to 34 inches; yellowish brown (10YR 5/6) clay; common fine prominent grayish brown (10YR 5/2) and few fine prominent red (2.5YR 4/6) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; few fine glacial pebbles; strongly acid; clear smooth boundary.

2Bt5—34 to 45 inches; mixed yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) clay; few fine distinct brown (7.5YR 4/4) and common fine prominent grayish brown (10YR 5/2) mottles; weak very fine subangular blocky structure; firm; common distinct clay films on faces of peds; common medium concretions of iron and manganese oxide; common fine glacial pebbles; medium acid; abrupt smooth boundary.

2Bt6—45 to 69 inches; light brownish gray (2.5Y 6/2) clay; common coarse prominent yellowish brown (10YR 5/8) and few medium prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very firm; few fine concretions of iron and manganese oxide; common distinct clay films on faces of peds; weak pressure faces; neutral.

The Ap horizon typically is loam or cobbly loam, but the range includes clay loam. The BE horizon has hue of 10YR or 7.5YR and value of 3 to 5. The 2Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6 in the upper part and hue of 7.5YR or 2.5Y, value of 5 or 6, and chroma of 2 to 6 in the lower part.

Armstrong Series

The Armstrong series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in a thin layer of loess or pedisediments and in the underlying glacial till. Slopes range from 5 to 14 percent.

Typical pedon of Armstrong loam, 5 to 9 percent slopes, eroded, 4,250 feet east and 1,415 feet north of the southwest corner of sec. 29, T. 49 N., R. 8 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; many fine roots; medium acid; abrupt smooth boundary.

Bt1—6 to 10 inches; dark yellowish brown (10YR 4/6) clay loam; weak very fine subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; few dark stains; few fine concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

2Bt2—10 to 15 inches; reddish brown (7.5YR 4/4) clay; few fine prominent grayish brown (10YR 5/2) and yellowish red (5YR 4/6) mottles; moderate fine subangular blocky structure; firm; common fine roots; few fine concretions of iron and manganese oxide; few fine glacial pebbles; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt3—15 to 22 inches; mottled yellowish brown (10YR 5/6), light brownish gray (10YR 6/2), and red (2.5YR 4/6) clay; weak fine subangular blocky structure; firm; common fine roots; few fine concretions of iron and manganese oxide; few fine glacial pebbles; common distinct clay films on faces of peds; very strongly acid; gradual smooth boundary.

2Bt4—22 to 28 inches; light brownish gray (10YR 6/2) clay loam; common fine prominent yellowish brown (10YR 5/6) and few fine prominent red (2.5YR 4/6) mottles; weak fine subangular blocky structure; firm; few fine roots; few fine concretions of iron and manganese oxide; few fine glacial pebbles; common distinct clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt5—28 to 36 inches; yellowish brown (10YR 5/6) clay loam; common fine prominent light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; few fine roots; few dark stains; few fine concretions of iron and manganese oxide; few fine glacial pebbles; few faint clay films on faces of peds; very strongly acid; gradual smooth boundary.

2Bt6—36 to 49 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent gray (10YR 6/1), few fine distinct brownish yellowish (10YR 6/8), and few fine prominent yellowish red (5YR 4/8) mottles; weak medium subangular blocky structure; firm; few fine roots; few fine concretions of iron and manganese oxide; few fine glacial pebbles; few faint clay films on faces of peds; medium acid; gradual smooth boundary.

2BC—49 to 66 inches; dark yellowish brown (10YR 4/6) clay loam; common fine faint yellowish brown (10YR 5/6), few fine distinct yellowish brown (10YR 5/8), and common medium prominent light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; few black stains; few fine concretions of iron and manganese oxide; few fine glacial pebbles; neutral.

In some pedons the E horizon has not been incorporated into the Ap horizon. It has value of 4 or 5 and chroma of 2 or 3. The Ap and E horizons are loam or silt loam. The upper part of the 2Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. The next part has hue of 10YR or 2.5YR, value of 4 to 6, and chroma of 2 to 6. The lower part of the 2Bt horizon and the 2BC horizon have hue of 10YR or 7.5YR and chroma of 3 to 6.

Auxvasse Series

The Auxvasse series consists of deep, somewhat poorly drained soils on low stream terraces. These soils formed in alluvium. Permeability is very slow. Slopes range from 0 to 3 percent.

Typical pedon of Auxvasse silt loam, 0 to 3 percent slopes, 1,220 feet east and 1,940 feet north of the southwest corner of sec. 22, T. 49 N., R. 9 W.

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak very fine granular structure; very friable; many fine concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

E—9 to 18 inches; pale brown (10YR 6/3) silt loam; moderate thin platy structure; friable; many fine pores and vesicles; many fine concretions of iron and manganese oxide; medium acid; abrupt smooth boundary.

B/E—18 to 21 inches; yellowish brown (10YR 5/6) silty clay (Bt); many fine prominent strong brown (7.5YR 5/8) mottles; strong fine subangular blocky structure; friable; thick continuous light brownish gray (2.5Y 6/2) silt coatings (E) on faces of peds and as fillings in vertical cracks, white (N 8/0) dry; very strongly acid; abrupt smooth boundary.

Btg—21 to 31 inches; grayish brown (2.5Y 5/2) silty clay; common fine prominent dark yellowish brown (10YR 4/4) mottles; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) kneaded; moderate fine angular blocky structure; very firm; many faint clay films on faces of peds; many fine concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

Cg—31 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; many fine prominent strong brown (7.5YR 5/6) mottles; massive; very firm; many fine concretions of iron and manganese oxide; very strongly acid.

The Ap horizon has chroma of 2 or 3. The E horizon has value of 5 or 6 and chroma of 2 or 3. The B part of the B/E horizon has value of 5 or 6 and chroma of 4 to 8. The E part has value of 5 or 6 and chroma of 2 or 3. The Btg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. The content of clay in this horizon ranges from 45 to 60 percent. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It is silt loam or silty clay loam.

Belknap Series

The Belknap series consists of deep, somewhat poorly drained, moderately permeable soils on the flood plains along the Missouri River and its tributaries. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Belknap silt loam, 1,950 feet east of the northwest corner of sec. 31, T. 47 N., R. 9 W.

Ap—0 to 13 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak thin platy structure parting to weak fine granular; friable;

common medium roots; strongly acid; clear smooth boundary.

Cg1—13 to 22 inches; dark grayish brown (10YR 4/2) silt loam; few fine prominent strong brown (7.5YR 5/8) and red (2.5YR 4/8) mottles; weak medium granular structure; friable; common fine roots; few wormcasts; strongly acid; clear smooth boundary.

Cg2—22 to 37 inches; grayish brown (10YR 5/2) silt loam; few fine prominent yellowish red (5YR 5/8) mottles; weak medium granular structure; friable; common fine roots; strongly acid; clear smooth boundary.

Cg3—37 to 41 inches; light brownish gray (10YR 6/2) and light gray (10YR 6/1) silt loam; few medium prominent yellowish red (5YR 5/8) mottles; massive; friable; few fine roots; very strongly acid; clear smooth boundary.

Cg4—41 to 60 inches; grayish brown (10YR 5/2) silt loam; few fine prominent strong brown (7.5YR 5/8) mottles; massive; friable; few fine roots; common black stains in cracks; few white (10YR 8/1) silt coatings; very strongly acid.

The A horizon has chroma of 2 or 3. The Cg horizon has chroma of 1 or 2.

Bethesda Series

The Bethesda series consists of deep, well drained soils in mine spoil areas that were surface mined for coal or fireclay. These soils formed in acid regolith derived from the mine spoil. Permeability is moderately slow. Slopes range from 5 to 60 percent.

Typical pedon of Bethesda shaly silty clay loam, in an area of Bethesda-Dumps complex, 5 to 60 percent slopes; 4,260 feet south and 1,050 feet east of the northwest corner of sec. 14, T. 49 N., R. 11 W.

A—0 to 6 inches; variegated light brownish gray (2.5Y 6/2), light olive brown (2.5Y 5/4), and dark yellowish brown (10YR 4/6) shaly silty clay loam, variegated white (5Y 8/1), pale yellow (2.5Y 7/4), and brownish yellow (10YR 6/8) dry; moderate very fine subangular blocky structure; friable; many medium roots; about 30 percent soft shale fragments less than 3 inches in size; extremely acid; clear wavy boundary.

C1—6 to 16 inches; variegated light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) very shaly silty clay loam; moderate fine subangular blocky structure; friable; common fine roots; about 55 percent soft shale and chert fragments less than 3 inches in size, 5 percent more than 3 inches in size; extremely acid; clear wavy boundary.

C2—16 to 33 inches; grayish brown (10YR 5/2) very shaly silty clay loam; weak fine subangular blocky structure; firm; few fine roots; pockets of reddish brown (5YR 4/4) material; about 55 percent soft shale and chert fragments less than 3 inches in size, 5 percent more than 3 inches in size; extremely acid; clear wavy boundary.

C3—33 to 49 inches; variegated light brownish gray (2.5Y 6/2), brownish yellowish (10YR 6/8), and reddish brown (5YR 4/4) very shaly silty clay loam; weak fine subangular blocky structure; friable; few fine roots; few pale yellow (5Y 7/4) stains; about 60 percent soft shale and chert fragments less than 3 inches in size; extremely acid; abrupt wavy boundary.

C4—49 to 60 inches; light olive gray (5Y 6/2) very shaly silty clay loam; common coarse prominent yellowish brown (10YR 5/8) mottles; massive; friable; about 40 percent soft shale fragments less than 3 inches in size; few pale yellow (5Y 7/4) stains; extremely acid.

The depth to bedrock is more than 5 feet. The A horizon has hue of 7.5YR or 5Y and chroma of 1 to 6. The C horizon has value of 4 to 6 and chroma of 1 to 6. The content of coarse fragments in this horizon ranges from 35 to 80 percent and averages about 60 percent. Some pedons have a few coarse fragments of coal.

Booker Series

The Booker series consists of deep, very poorly drained, very slowly permeable soils on the flood plains along the Missouri River. These soils formed in clayey alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Booker silty clay, 1,300 feet north and 300 feet east of the southwest corner of sec. 33, T. 45 N., R. 9 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm; many fine roots; neutral; abrupt smooth boundary.

BA—6 to 12 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; very firm; common fine roots; slightly acid; clear smooth boundary.

Bw—12 to 20 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine prominent dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky structure; very firm; common fine roots; medium acid; gradual smooth boundary.

Bg1—20 to 35 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; few medium prominent dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; very firm; common fine roots; medium acid; gradual smooth boundary.

Bg2—35 to 47 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay, dark gray (10YR 4/1) dry; few fine prominent dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky structure; very firm; common very fine roots; medium acid; clear smooth boundary.

Bg3—47 to 53 inches; dark gray (10YR 4/1) clay; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; very firm; few very fine roots; few dark stains and concretions of iron and manganese oxide; neutral; clear smooth boundary.

BCg—53 to 58 inches; dark gray (10YR 4/1) clay; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak very fine subangular blocky structure; very firm; few very fine roots; few dark stains of iron and manganese oxide; neutral; clear smooth boundary.

Cg—58 to 75 inches; dark gray (10YR 4/1) clay; many medium distinct dark yellowish brown (10YR 4/4) mottles; massive; very firm; neutral.

The B horizon has value of 3 or less and chroma of 2 or less to a depth of about 35 inches. Below that depth, it has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 or less. It has distinct or prominent mottles with value of 3 to 5 and chroma of 3 to 6. The Bg horizon averages 60 or more percent clay. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2.

Calwoods Series

The Calwoods series consists of deep, somewhat poorly drained soils on uplands. These soils formed in loess and pedisediments over glacial till. Permeability is very slow. Slopes range from 2 to 5 percent.

Typical pedon of Calwoods silt loam, 2 to 5 percent slopes, eroded, 2,500 feet south and 2,300 feet east of the northwest corner of sec. 27, T. 46 N., R. 11 W.

Ap—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

BE—4 to 8 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine prominent red (2.5YR 4/6) mottles; weak very fine subangular blocky structure; firm; common fine roots; strongly acid; abrupt smooth boundary.

Bt1—8 to 13 inches; grayish brown (10YR 5/2) silty clay; common fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; common fine roots; many distinct clay films on faces of peds; few fine concretions of iron and manganese; very strongly acid; clear smooth boundary.

Bt2—13 to 22 inches; grayish brown (10YR 5/2) silty clay loam; common medium and fine distinct dark yellowish brown (10YR 4/4) and few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; common fine roots; many distinct clay films on faces of peds; common fine stains and concretions of iron and manganese oxide; strongly acid; clear smooth boundary.

Bt3—22 to 30 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) and few fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; medium acid; abrupt smooth boundary.

BC—30 to 38 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine prominent dark yellowish brown (10YR 4/4) mottles; moderate thick platy structure parting to weak fine subangular; firm; few fine roots; few fine concretions of iron and manganese oxide; few grayish brown (10YR 5/2) silt coatings; neutral; abrupt smooth boundary.

2C—38 to 68 inches; grayish brown (2.5Y 5/2) clay loam; common medium prominent dark yellowish brown (10YR 4/6) and common fine prominent dark yellowish brown (10YR 4/4) mottles; weak very fine subangular blocky structure; firm; few very fine roots; common black stains and concretions of iron and manganese oxide, increasing in number with increasing depth; neutral.

The Ap horizon has value of 3 to 5 and chroma of 2 or 3. It is mainly silt loam, but the range includes silty clay loam. The BE horizon has value of 4 or 5 and chroma of 3 or 4. It is silt loam or silty clay loam. The Bt horizon has hue of 10YR or 2.5Y and value of 4 to 6. It is silty clay or silty clay loam. The 2C horizon has value of 5 or 6.

Cedargap Series

The Cedargap series consists of deep, well drained soils on flood plains along small streams. These soils formed in cherty, loamy alluvium. Permeability is moderately rapid. Slopes range from 0 to 2 percent.

Typical pedon of Cedargap loam, 400 feet south and 2,640 feet west of the northeast corner of sec. 32, T. 47 N., R. 8 W.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; common fine roots; few pieces of angular chert; slightly acid; clear smooth boundary.

A2—7 to 15 inches; dark brown (10YR 3/3) very cherty loam, brown (10YR 5/3) dry; weak very fine subangular blocky structure; friable; common fine roots; about 35 percent chert; neutral; clear smooth boundary.

A3—15 to 24 inches; dark brown (10YR 3/3) very cherty loam, brown (10YR 5/3) dry; weak very fine subangular blocky structure; friable; few fine roots; about 60 percent chert; neutral; clear smooth boundary.

C1—24 to 38 inches; dark brown (10YR 4/3) very cherty loam; weak very fine subangular blocky structure; friable; few fine roots; about 40 percent chert; neutral; gradual smooth boundary.

C2—38 to 60 inches; dark brown (10YR 3/3) and brown (10YR 4/3) extremely cherty loam; weak very fine subangular blocky structure; friable; few fine roots; about 75 percent chert; neutral.

The thickness of the mollic epipedon ranges from 24 to 36 inches. The content of chert in the 10- to 40-inch zone ranges from 35 to 75 percent. The A horizon is loam in the upper part and cherty or very cherty loam in the lower part. The C horizon has value of 3 to 5 and chroma of 3 or 4.

Crider Series

The Crider series consists of deep, well drained soils on uplands. These soils formed in loess and in the underlying limestone residuum or old alluvium. Permeability is moderate. Slopes range from 5 to 14 percent.

Typical pedon of Crider silt loam, 5 to 9 percent slopes, eroded, 700 feet south and 2,350 feet east of the northwest corner of sec. 17, T. 48 N., R. 8 W.

Ap—0 to 8 inches; dark brown (10YR 4/3) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; many very fine and fine roots; slightly acid; abrupt smooth boundary.

BA—8 to 12 inches; dark brown (7.5YR 4/4) silt loam; weak very fine subangular blocky structure; friable; common very fine and fine roots; slightly acid; clear smooth boundary.

Bt1—12 to 18 inches; dark brown (7.5YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—18 to 25 inches; reddish brown (5YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; few pale brown silt coatings; few quartz grains; strongly acid; gradual smooth boundary.

Bt3—25 to 38 inches; reddish brown (5YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; common distinct thick clay films on faces of peds; few fine concretions of iron and manganese oxide; few pale brown silt coatings; few quartz grains; strongly acid; clear smooth boundary.

2Bt4—38 to 48 inches; red (2.5YR 4/6) silty clay loam; few fine distinct yellowish red (5YR 4/6) and few fine prominent dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; common distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; few brown silt coatings in cracks and pores; few quartz grains; strongly acid; clear smooth boundary.

2Bt5—48 to 70 inches; red (2.5YR 4/6) silty clay loam; weak fine subangular blocky structure; firm; common distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; few brown silt coatings in cracks and pores; few quartz grains; strongly acid.

The Ap horizon has hue of 10YR or 7.5YR and chroma of 2 to 4. The BA horizon has hue of 10YR or 7.5YR. It commonly is silt loam but is silty clay loam in some pedons. The Bt horizon has value of 4 or 5 and chroma of 4 to 6 in the upper part and has hue of 2.5YR or 5YR, value of 3 or 4, and chroma of 4 to 6 in the lower part. In some pedons the lower part of the 2Bt horizon has a few chert pebbles.

Dupo Series

The Dupo series consists of deep, somewhat poorly drained soils on the flood plains along the Missouri River. These soils formed in silty alluvium. Permeability is moderate in the upper part of the profile and slow in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Dupo silt loam, 900 feet south and 2,000 feet east of the northwest corner of sec. 14, T. 44 N., R. 11 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common medium faint dark brown (10YR 4/3) mottles; weak very fine granular structure; friable; common very fine roots; common very fine pores; neutral; abrupt smooth boundary.

C1—8 to 24 inches; dark brown (10YR 4/3) and dark grayish brown (10YR 4/2) silt loam; few fine faint grayish brown (10YR 5/2) mottles; weak fine granular structure; friable; few very fine roots; common very fine pores; slightly acid; clear smooth boundary.

C2—24 to 39 inches; dark grayish brown (10YR 4/2) silt loam; many medium faint dark brown (10YR 4/3) and few fine faint grayish brown (10YR 5/2) mottles; weak fine granular structure; friable; few very fine roots; common fine and very fine pores; neutral; abrupt smooth boundary.

2Ab—39 to 51 inches; very dark gray (10YR 3/1) silty clay loam; many medium distinct dark brown (10YR 4/3) mottles; weak fine subangular blocky structure; firm; few very fine pores; neutral; abrupt smooth boundary.

2C—51 to 68 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium faint grayish brown (10YR 5/2) and brown (10YR 5/3) mottles; weak fine subangular blocky structure; firm; common fine and very fine pores; neutral.

The depth to a buried horizon is 24 to 40 inches. The A horizon has chroma of 2 or 3. The C horizon has value of 3 or 4. The 2Ab and 2C horizons are silty clay loam or silty clay.

Freeburg Series

The Freeburg series consists of deep, somewhat poorly drained soils on low terraces along small streams and creeks. These soils formed in silty alluvium. Permeability is moderately slow. Slopes range from 3 to 9 percent.

Typical pedon of Freeburg silt loam, 3 to 9 percent slopes, 3,190 feet south and 910 feet east of the northwest corner of sec. 33, T. 46 N., R. 7 W.

Ap—0 to 5 inches; mixed very dark grayish brown (10YR 3/2) and dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak fine granular structure; friable; common medium roots; slightly acid; abrupt smooth boundary.

BA—5 to 11 inches; brown (10YR 5/3) silty clay loam; weak very fine subangular blocky structure; friable; common very fine roots; slightly acid; clear smooth boundary.

Bt1—11 to 15 inches; brown (10YR 5/3) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; firm; common very fine roots; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—15 to 20 inches; brown (10YR 5/3) silty clay loam; common fine distinct dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; firm; common very fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; strongly acid; clear smooth boundary.

Bt3—20 to 26 inches; brown (10YR 5/3) silty clay loam; many fine faint light brownish gray (10YR 6/2) and common fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; few light gray silt coatings; common distinct clay films on faces of peds; very strongly acid; clear smooth boundary.

BC—26 to 33 inches; grayish brown (10YR 5/2) silty clay loam; many fine prominent strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; firm; few fine concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

C1—33 to 45 inches; grayish brown (10YR 5/2) silty clay loam; many medium prominent strong brown (7.5YR 5/8) mottles; weak coarse subangular blocky structure; firm; few fine concretions of iron and manganese oxide; numerous light gray silt coatings; very strongly acid; clear smooth boundary.

C2—45 to 60 inches; grayish brown (10YR 5/2) silty clay loam; common medium faint brown (10YR 5/3), many fine faint dark gray (10YR 4/1), and many medium prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak fine subangular blocky structure; friable; few fine concretions of iron and manganese oxide; few light gray silt coatings; strongly acid.

The Ap horizon has value of 4 or 5. Some pedons have an E horizon, which has value of 5 or 6 and chroma of 2 or 3. The upper part of the Bt horizon has value of 4 or 5.

Gasconade Series

The Gasconade series consists of shallow, somewhat excessively drained soils on dissected uplands. These soils formed in a thin layer of clayey limestone residuum. Permeability is moderately slow. Slopes range from 5 to 35 percent.

Typical pedon of Gasconade flaggy silty clay loam, in an area of Goss-Gasconade-Rock outcrop complex, 5 to 35 percent slopes; 2,380 feet west and 1,320 feet south of the northeast corner of sec. 25, T. 47 N., R. 9 W.

A—0 to 9 inches; very dark brown (10YR 2/2) flaggy silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; firm; about 20 percent limestone and chert fragments; common roots; neutral; clear smooth boundary.

Bw—9 to 17 inches; dark brown (10YR 4/4) very flaggy silty clay; moderate fine and very fine subangular blocky structure; firm; about 40 percent limestone and chert fragments; mildly alkaline; clear smooth boundary.

R—17 inches; hard limestone bedrock.

The depth to limestone bedrock ranges from 4 to 20 inches. In much of the profile, the content of coarse fragments more than 3 inches in diameter ranges from 35 to 60 percent, but the A horizon commonly has less than 35 percent.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is mainly flaggy silty clay loam, but the range includes flaggy silty clay. The Bw horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It is very flaggy clay or very flaggy silty clay.

Gorin Series

The Gorin series consists of deep, somewhat poorly drained soils on uplands. These soils formed in loess and pedisediments. Permeability is slow. Slopes range from 3 to 9 percent.

Typical pedon of Gorin silt loam, 3 to 9 percent slopes, 200 feet west and 550 feet south of the northeast corner of sec. 5, T. 47 N., R. 10 W.

A—0 to 3 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; very friable; common fine and few medium roots; strongly acid; abrupt smooth boundary.

E—3 to 8 inches; brown (10YR 5/3) silt loam, light gray (10YR 7/2) dry; moderate fine granular structure; friable; common fine and few medium roots; strongly acid; clear smooth boundary.

BE—8 to 12 inches; brown (7.5YR 5/4) silty clay loam; many fine distinct brown (10YR 5/3) mottles; moderate fine subangular blocky structure; friable; few fine roots; few fine concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

Bt1—12 to 19 inches; brown (7.5YR 5/4) silty clay loam; many medium faint dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

Bt2—19 to 24 inches; brown (7.5YR 5/4) silty clay; common medium prominent light brownish gray (2.5Y 6/2), common fine distinct strong brown (7.5YR 5/6), and many fine distinct strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure; very firm; few roots; common distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; very strongly acid; gradual smooth boundary.

Bt3—24 to 35 inches; brown (10YR 5/3) silty clay; common medium distinct grayish brown (2.5Y 5/2) and common fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; strongly acid; gradual smooth boundary.

Bt4—35 to 46 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

2Bt5—46 to 51 inches; brown (10YR 5/3) silty clay loam; common medium distinct dark brown (7.5YR 4/4) and light brownish gray (2.5Y 6/2) and common medium prominent strong brown (7.5YR 4/6 and 5/6) mottles; moderate fine subangular blocky structure; firm; few faint clay films on faces of peds; common fine sand grains; few fine concretions of iron and manganese oxide; strongly acid; clear smooth boundary.

2Bt6—51 to 60 inches; brown (10YR 5/3) silty clay loam; many fine faint grayish brown (10YR 5/2) and light gray (10YR 7/2) and many fine prominent yellowish red (5YR 4/6) mottles; strong fine subangular blocky structure; firm; few faint clay films on faces of peds; common fine sand grains; medium acid.

The A or Ap horizon has value of 3 or 4 and chroma of 1 or 2. The lower part of the Bt horizon has chroma of 2 to 4. The 2Bt horizon has chroma of 3 or 4.

Gosport Series

The Gosport series consists of moderately deep, moderately well drained soils on uplands. These soils formed in acid shale residuum. Permeability is very slow. Slopes range from 5 to 30 percent.

Typical pedon of Gosport silt loam, 5 to 30 percent slopes, 225 feet north and 2,520 feet east of the southwest corner of sec. 24, T. 49 N., R. 7 W.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine granular structure; friable; common medium roots; slightly acid; clear smooth boundary.
BA—5 to 9 inches; mixed brown (10YR 5/3) and yellowish brown (10YR 5/4) silt loam; weak fine granular structure; friable; dark grayish brown coatings in the upper part; common shale fragments; common medium roots; strongly acid; clear smooth boundary.
Bw1—9 to 16 inches; yellowish brown (10YR 5/4) silty clay; common fine prominent red (2.5YR 4/6) and few fine distinct pale brown (10YR 6/3) mottles; weak very fine subangular blocky structure; firm; few fine roots; extremely acid; gradual smooth boundary.
Bw2—16 to 21 inches; yellowish brown (10YR 5/4) silty clay; few fine prominent mottles that are yellowish red (5YR 5/6) in the upper part of the horizon and light brownish gray (2.5Y 6/2) in the lower part; weak very fine subangular blocky structure; firm; few fine roots; extremely acid; gradual smooth boundary.
Bw3—21 to 25 inches; mottled light brownish gray (2.5Y 6/2), yellowish red (5YR 5/6), and yellowish brown (10YR 5/4 and 5/6) silty clay; weak fine subangular blocky structure; firm; few fine roots; extremely acid; gradual smooth boundary.
Bw4—25 to 33 inches; yellowish brown (10YR 5/4) silty clay; common fine prominent yellowish red (5YR 5/6) and few fine prominent light brownish gray (2.5Y 6/2) mottles; moderate medium platy structure; firm; few fine roots; common shale fragments; light olive gray (5Y 6/2) plates of shale; very strongly acid; gradual smooth boundary.
Cr—33 to 60 inches; light olive gray (5Y 6/2), weathered shale.

The A horizon has value of 3 or 4. The BA horizon has chroma of 3 or 4. The Bw horizon has chroma of 2 to 6.

Goss Series

The Goss series consists of deep, well drained soils on uplands. These soils formed in cherty limestone residuum. Permeability is moderate. Slopes range from 5 to 35 percent.

Typical pedon of Goss cherty silt loam, in an area of Goss-Gasconade-Rock outcrop complex, 5 to 35 percent slopes; 670 feet north and 400 feet west of the southeast corner of sec. 2, T. 46 N., R. 9 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) cherty silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine roots; about 30 percent chert fragments; medium acid; abrupt smooth boundary.
E—3 to 11 inches; light yellowish brown (10YR 6/4) very cherty silt loam; weak fine granular structure; friable; common fine roots; about 50 percent chert fragments; strongly acid; clear smooth boundary.
BE—11 to 14 inches; reddish brown (2.5YR 5/4) and yellowish red (5YR 5/6) very cherty silty clay loam; moderate fine subangular blocky structure; firm; common fine roots; about 40 percent chert fragments; very strongly acid; abrupt smooth boundary.
Bt1—14 to 21 inches; yellowish red (5YR 5/6) very cherty silty clay; few fine distinct red (2.5YR 4/6) mottles; few fine prominent grayish brown (10YR 5/2) mottles in root channels; moderate medium subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; about 35 percent chert fragments; strongly acid; clear smooth boundary.
Bt2—21 to 28 inches; yellowish red (5YR 5/6) very cherty silty clay; common medium distinct red (2.5YR 4/6) mottles; moderate fine subangular blocky structure; firm; common fine and medium roots; common faint clay films on faces of peds; about 35 percent chert fragments; strongly acid; gradual smooth boundary.
Bt3—28 to 48 inches; reddish brown (5YR 5/4) very cherty silty clay; few fine prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; about 40 percent chert fragments; strongly acid; gradual smooth boundary.
Bt4—48 to 60 inches; brown (7.5YR 5/4) very cherty silty clay; few fine prominent red (2.5YR 4/6) and few fine distinct pale brown (10YR 6/3) mottles; moderate fine and medium subangular blocky structure; few faint clay films on faces of peds; firm; about 40 percent chert fragments; slightly acid.

The A horizon has chroma of 1 to 3. The content of chert fragments is 15 to 60 percent in the E horizon and 35 to 45 percent in the Bt horizon. The Bt horizon has hue of 2.5YR or 7.5YR and chroma of 4 to 6.

Grable Series

The Grable series consists of deep, well drained soils on the flood plains along the Missouri River. These soils formed in stratified alluvium. Permeability is moderate in the upper part of the profile, rapid in the next part, and moderately rapid in the lower part. Slopes range from 0 to 2 percent.

Typical pedon of Grable very fine sandy loam, loamy substratum, 2,200 feet west and 100 feet south of the northeast corner of sec. 22, T. 44 N., R. 11 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure parting to weak very fine granular; very friable; common fine roots; strong effervescence; mildly alkaline; abrupt smooth boundary.

C1—8 to 22 inches; brown (10YR 5/3) very fine sandy loam; few fine distinct dark yellowish brown (10YR 4/6) and many medium faint dark grayish brown (10YR 4/2) mottles; weak medium granular structure; very friable; few fine roots; few wormcasts; strong effervescence; mildly alkaline; clear smooth boundary.

2C2—22 to 34 inches; brown (10YR 5/3) fine sand; single grain; loose; strong effervescence; mildly alkaline; clear smooth boundary.

2C3—34 to 60 inches; stratified brown (10YR 5/3) and dark grayish brown (10YR 4/2) loamy very fine sand, very fine sandy loam, loamy fine sand, and silt loam; common medium distinct very dark gray (10YR 3/1), common medium faint grayish brown (10YR 5/2), and few medium prominent yellowish red (5YR 4/6) mottles; massive; very friable; strong effervescence; mildly alkaline.

The A horizon is dominantly very fine sandy loam, but the range includes silt loam. The C1 and 2C3 horizons have strata with chroma of 2 or 3.

Hatton Series

The Hatton series consists of deep, moderately well drained soils on uplands. These soils formed in loess and silty pedisediments underlain by glacial till. Permeability is very slow. Slopes range from 3 to 9 percent.

Typical pedon of Hatton silt loam, 3 to 9 percent slopes, 2,380 feet south and 1,800 feet west of the northeast corner of sec. 32, T. 48 N., R. 9 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine granular structure; friable; common medium roots; neutral; abrupt smooth boundary.

E—3 to 8 inches; brown (10YR 5/3) silt loam; weak medium platy structure parting to weak very fine granular; friable; common fine roots; slightly acid; clear smooth boundary.

Bt1—8 to 13 inches; strong brown (7.5YR 5/6) silty clay loam; moderate very fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; few pale brown silt coatings; very strongly acid; clear smooth boundary.

Bt2—13 to 20 inches; strong brown (7.5YR 5/6) silty clay loam; strong very fine and fine subangular blocky structure; firm; few fine roots; common pale brown silt coatings; common distinct clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt3—20 to 26 inches; dark brown (7.5YR 4/4) silty clay; weak fine and medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt4—26 to 31 inches; brown (10YR 5/3) silty clay; few fine faint grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) and many coarse distinct dark brown (7.5YR 4/4) mottles; weak fine and medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt5—31 to 38 inches; brown (10YR 5/3) silty clay loam; many coarse distinct dark brown (7.5YR 4/4) and many coarse faint light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; firm; few fine roots; many black stains; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

2Btx—38 to 52 inches; grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) silt loam; common medium distinct dark brown (7.5YR 4/4) mottles; weak very thick platy structure; firm; brittle; few fine roots along clay seams; many black stains; very strongly acid; clear smooth boundary.

2Bt—52 to 70 inches; brown (7.5YR 5/4) silty clay loam; common medium prominent grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; weak very fine subangular blocky structure; firm; few fine roots in clay seams; few faint clay films on faces of peds; increasing content of sand with increasing depth; medium acid.

The A or Ap horizon has value of 4 or 5 and chroma of 2 or 3. The E horizon has value of 5 or 6 and chroma of 3 or 4. Most cultivated areas do not have an E horizon.

Haymond Series

The Haymond series consists of deep, well drained soils on flood plains. These soils formed in silty alluvium. Permeability is moderate. Slopes range from 0 to 2 percent.

Typical pedon of Haymond silt loam, 1,400 feet north and 1,350 feet east of the southwest corner of sec. 15, T. 47 N., R. 8 W.

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak very fine granular structure; very friable; many fine roots; neutral; abrupt smooth boundary.

C1—7 to 28 inches; stratified dark brown (10YR 4/3) and brown (10YR 5/3) silt loam; weak very fine granular structure; very friable; common fine roots; neutral; abrupt smooth boundary.

C2—28 to 60 inches; dark brown (10YR 4/3) silt loam; few fine faint yellowish brown (10YR 5/6) mottles in the upper part; appears massive but has weak bedding planes; very friable; few thin strata of brown (10YR 5/3) fine sandy loam and very fine sandy loam along horizontal bedding planes; neutral.

The A horizon has chroma of 2 or 3. The C horizon has strata of silt loam with value of 4 or 5.

Hodge Series

The Hodge series consists of deep, somewhat excessively drained soils on the flood plains along the Missouri River. These soils formed in stratified alluvium. Permeability is rapid. Slopes range from 0 to 2 percent.

Typical pedon of Hodge fine sand, loamy substratum, 3,800 feet south and 800 feet west of the northeast corner of sec. 23, T. 44 N., R. 10 W.

Ap—0 to 8 inches; dark brown (10YR 4/3) fine sand, brown (10YR 5/3) dry; single grain; loose; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—8 to 31 inches; dark grayish brown (10YR 4/2) fine sand; single grain; loose; thinly stratified with lenses of loamy fine sand; slight effervescence; mildly alkaline; abrupt smooth boundary.

C2—31 to 53 inches; dark grayish brown (10YR 4/2) loamy fine sand; single grain; loose; very thin lamellae of grayish brown and brown silt loam; few thin strata of fine sandy loam; few fine prominent dark brown (7.5YR 4/4) stains; slight effervescence; mildly alkaline; abrupt smooth boundary.

C3—53 to 60 inches; stratified dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), and brown (10YR 5/3) silt loam; massive; friable; thin strata of loamy fine sand; slight effervescence; mildly alkaline.

The A horizon is dominantly fine sand, but the range includes fine sandy loam. The lower part of the C horizon typically is stratified silt loam that has thin strata of coarser textured material.

Keswick Series

The Keswick series consists of deep, moderately well drained soils on side slopes in the uplands. These soils formed in a thin layer of pedisediments and in the underlying weathered glacial till. Permeability is slow. Slopes range from 5 to 14 percent.

Typical pedon of Keswick loam, 9 to 14 percent slopes, eroded, 2,640 feet south and 80 feet west of the northeast corner of sec. 28, T. 48 N., R. 11 W.

Ap—0 to 5 inches; dark brown (10YR 4/3) loam, brown (10YR 5/3) dry; weak very fine granular structure; friable; many fine roots; few glacial pebbles; slightly acid; clear smooth boundary.

BE—5 to 11 inches; mixed dark brown (10YR 4/3) and dark yellowish brown (10YR 4/4) clay loam; few fine prominent yellowish red (5YR 4/6) mottles; weak very fine subangular blocky structure; friable; few fine concretions of iron and manganese oxide; few glacial pebbles; many fine roots; slightly acid; clear smooth boundary.

2Bt1—11 to 16 inches; strong brown (7.5YR 5/6) clay loam; few fine prominent yellowish red (5YR 4/6) and red (2.5YR 4/6) mottles; weak very fine subangular blocky structure; firm; many fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; few glacial pebbles; very strongly acid; clear smooth boundary.

2Bt2—16 to 21 inches; mottled dark brown (7.5YR 4/4), red (2.5YR 4/6), yellowish brown (10YR 5/6), and grayish brown (10YR 5/2) clay loam; weak fine subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; few fine concretions of iron and manganese oxide; few glacial pebbles; very strongly acid; clear smooth boundary.

2Bt3—21 to 25 inches; yellowish brown (10YR 5/6) clay loam; common fine prominent red (2.5YR 4/6), many fine prominent grayish brown (10YR 5/2), and few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm; few fine roots; many distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; few glacial pebbles; very strongly acid; clear smooth boundary.

2Bt4—25 to 32 inches; yellowish brown (10YR 5/6) clay; many fine prominent grayish brown (10YR 5/2), few fine prominent red (2.5YR 4/6), and few fine faint dark yellowish brown (10YR 4/6) mottles;

weak fine angular blocky structure; firm; few fine roots; many distinct clay films on faces of peds; common fine concretions of iron and manganese oxide; few glacial pebbles; very strongly acid; gradual smooth boundary.

2Bt5—32 to 39 inches; yellowish brown (10YR 5/6) clay loam; common coarse prominent light brownish gray (2.5Y 6/2) mottles; weak fine angular blocky structure; firm; few fine roots; many distinct brown (7.5YR 4/4) clay films on faces of peds; common fine black stains and concretions of iron and manganese oxide; few glacial pebbles; very strongly acid; clear smooth boundary.

2Bt6—39 to 51 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent light brownish gray (2.5Y 6/2) and reddish brown (5YR 4/4) and common medium distinct dark yellowish brown (10YR 4/4) mottles; weak fine angular blocky structure; firm; few fine roots; common fine concretions of iron and manganese oxide; few glacial pebbles; few dark brown (7.5YR 3/2) coatings; neutral; clear smooth boundary.

2C—51 to 60 inches; mottled yellowish brown (10YR 5/6), dark brown (7.5YR 4/4), light brownish gray (2.5Y 6/2), and dark yellowish brown (10YR 4/4) clay loam; weak medium subangular and angular blocky structure; firm; few faint clay films on faces of peds; few glacial pebbles; common fine concretions of iron and manganese oxide; neutral.

The thickness of the solum ranges from 42 to more than 60 inches. Most pedons do not have a stone line in the upper part of the 2Bt horizon. The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The 2Bt horizon has hue of 10YR, 7.5YR, or 5YR. The 2C horizon has chroma of 4 to 6.

Landes Series

The Landes series consists of deep, well drained soils on the flood plains and natural levees along the major streams. These soils formed in loamy alluvium. Permeability is moderately rapid. Slopes range from 0 to 2 percent.

Typical pedon of Landes loam, 1,480 feet north and 50 feet east of the southwest corner of sec. 9, T. 47 N., R. 8 W.

Ap—0 to 4 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 5/3) dry; weak very fine granular structure; very friable; many medium roots; few wormcasts; neutral; abrupt smooth boundary.

A—4 to 12 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 5/3) dry; weak very fine granular structure; very friable; common fine roots; few wormcasts; neutral; gradual smooth boundary.

C1—12 to 26 inches; dark yellowish brown (10YR 4/4) fine sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; appears massive but has weak bedding planes; very friable; few fine roots; slightly acid; clear smooth boundary.

C2—26 to 31 inches; dark yellowish brown (10YR 4/4) fine sandy loam; appears massive but has weak bedding planes; very friable; few fine roots; slightly acid; clear smooth boundary.

C3—31 to 51 inches; brown (10YR 5/3) fine sandy loam; few medium prominent dark yellowish brown (10YR 4/6) mottles; appears massive but has weak bedding planes; very friable; few fine roots; medium acid; clear smooth boundary.

C4—51 to 60 inches; brown (10YR 5/3) fine sandy loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; appears massive but has weak bedding planes; friable; medium acid.

The C horizon has value of 4 or 5. It is fine sandy loam or fine sand.

Leta Series

The Leta series consists of deep, somewhat poorly drained soils on the flood plains along the Missouri River. These soils formed in stratified alluvium. Permeability is slow in the subsoil and moderate in the upper part of the substratum. Slopes range from 0 to 2 percent.

Typical pedon of Leta silty clay loam, sandy substratum, 1,860 feet east of the southwest corner of sec. 14, T. 44 N., R. 11 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; firm; few very fine roots; neutral; abrupt smooth boundary.

A—6 to 11 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; firm; few very fine roots; few very fine pores; neutral; clear smooth boundary.

Bw1—11 to 16 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine faint dark grayish brown (10YR 4/2) and dark brown (10YR 4/3) mottles; moderate fine and medium subangular blocky structure; firm; few very fine roots; few very fine pores; neutral; clear smooth boundary.

Bw2—16 to 25 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium faint dark brown

(10YR 4/3) mottles; weak fine and medium subangular blocky structure; firm; few very fine roots; common fine pores; neutral; clear smooth boundary.

2C1—25 to 33 inches; dark grayish brown (10YR 4/2) very fine sandy loam; few fine faint dark yellowish brown (10YR 4/4) mottles; massive; friable; few very fine roots; common fine pores; slight effervescence; mildly alkaline; clear smooth boundary.

2C2—33 to 44 inches; grayish brown (10YR 5/2), stratified very fine sandy loam and silt loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; appears massive but has weak bedding planes; friable; few very fine roots; common fine pores; slight effervescence; mildly alkaline; clear smooth boundary.

2C3—44 to 72 inches; grayish brown (10YR 5/2) fine sand; single grain; loose; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 34 inches. The thickness of the mollic epipedon ranges from 14 to 19 inches.

The A horizon is dominantly silty clay loam, but the range includes silt loam. The Bw horizon has value of 3 or 4. The darker colors are in the upper part. This horizon is silty clay loam or silty clay and ranges from 35 to 48 percent clay. The 2C horizon has value of 4 or 5. It is very fine sandy loam, silt loam, or fine sand.

Lily Series

The Lily series consists of moderately deep, well drained soils on uplands. These soils formed in sandstone residuum. Permeability is moderately rapid. Slopes range from 5 to 35 percent.

Typical pedon of Lily loam, in an area of Lily-Winfield-Rock outcrop complex, 5 to 35 percent slopes; 550 feet west and 2,600 feet south of the northeast corner of sec. 23, T. 46 N., R. 7 W.

A—0 to 6 inches; dark brown (10YR 4/3) loam; weak very fine granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

Bt1—6 to 15 inches; dark brown (7.5YR 4/4) clay loam; weak very fine subangular blocky structure; friable; few medium roots; few faint clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt2—15 to 24 inches; dark brown (7.5YR 4/4) clay loam; few fine distinct strong brown (7.5YR 5/6) and brown (10YR 5/3) and few fine prominent grayish brown (10YR 5/2) mottles in the lower part; weak fine subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

BC—24 to 29 inches; dark brown (7.5YR 4/4) sandy clay loam; few fine prominent grayish brown (10YR 5/2) and few fine distinct brown (10YR 5/3) and reddish brown (5YR 4/4) mottles; moderate medium platy structure; friable; few fine roots; very strongly acid; clear smooth boundary.

C—29 to 32 inches; dark brown (7.5YR 4/4) sandy clay loam; few fine prominent grayish brown (10YR 5/2) and few fine distinct brown (10YR 5/3) and reddish brown (5YR 4/4) mottles; massive; friable; very strongly acid; clear smooth boundary.

R—32 inches; hard sandstone bedrock.

The depth to sandstone bedrock ranges from 20 to 40 inches. The Bt, BC, and C horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6.

Lindley Series

The Lindley series consists of deep, well drained soils on uplands. These soils formed in glacial till. Permeability is moderately slow. Slopes range from 9 to 30 percent.

Typical pedon of Lindley loam, 14 to 30 percent slopes, 1,900 feet west and 2,000 feet south of the northeast corner of sec. 32, T. 48 N., R. 9 W.

A—0 to 1 inch; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

E—1 to 5 inches; brown (10YR 5/3) loam; few fine faint dark grayish brown (10YR 4/2) and few fine prominent strong brown (7.5YR 5/6) mottles; weak very fine granular structure; friable; common fine roots; few glacial pebbles; strongly acid; abrupt smooth boundary.

Bt1—5 to 8 inches; strong brown (7.5YR 5/6) clay loam; common brown (10YR 5/3) silt coatings on faces of peds; weak very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; few glacial pebbles; very strongly acid; clear smooth boundary.

Bt2—8 to 15 inches; strong brown (7.5YR 5/6) clay loam; moderate fine and very fine subangular blocky structure; firm; few fine roots; many prominent clay films on faces of peds; few glacial pebbles; very strongly acid; clear smooth boundary.

Bt3—15 to 30 inches; yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) clay loam; common fine and medium prominent light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; firm; few fine roots; many prominent clay films on faces of peds; few glacial pebbles; very strongly acid; clear smooth boundary.

Bt4—30 to 50 inches; strong brown (7.5YR 5/6) clay loam; many medium prominent grayish brown (10YR 5/2) and few fine prominent reddish brown (5YR 4/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; many prominent clay films on faces of peds; few glacial pebbles; common black stains in the lower part; very strongly acid; clear smooth boundary.

C—50 to 60 inches; strong brown (7.5YR 5/6) clay loam; common medium prominent grayish brown (10YR 5/2) and few fine prominent reddish brown (5YR 4/4) mottles; massive; firm; few glacial pebbles; common coarse black stains; weathered calcareous masses; mildly alkaline.

The Bt horizon has chroma of 4 to 8.

Marion Series

The Marion series consists of deep, somewhat poorly drained soils on uplands. These soils formed in loess. Permeability is very slow. Slopes range from 0 to 2 percent.

Typical pedon of Marion silt loam, 1,500 feet north and 2,040 feet east of the southwest corner of sec. 34, T. 47 N., R. 9 W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate very fine granular structure; very friable; many fine roots and pores; slightly acid; abrupt smooth boundary.

E1—2 to 6 inches; brown (10YR 5/3) silt loam; common fine faint light brownish gray (10YR 6/2) mottles; weak very fine granular structure; friable; many fine roots; strongly acid; abrupt smooth boundary.

E2—6 to 11 inches; light gray (2.5Y 7/2) silt loam; weak medium platy structure parting to weak very fine subangular blocky; friable; common fine roots; few dark yellowish brown stains; many concretions of iron and manganese oxide; strongly acid; abrupt smooth boundary.

Bt1—11 to 15 inches; brown (10YR 5/3) silty clay; common fine faint light brownish gray (10YR 6/2) and few fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; very firm; few fine roots; thick white (10YR 8/2) silt coatings on faces of peds; few concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

Bt2—15 to 27 inches; yellowish brown (10YR 5/4) silty clay; few fine distinct light gray (10YR 7/2) and few fine faint dark yellowish brown (10YR 4/4) mottles; weak very fine subangular blocky structure; very firm; few fine roots; many prominent clay films on faces of peds; few discontinuous silt coatings on faces of peds; very strongly acid; clear smooth boundary.

BC—27 to 42 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; very firm; strongly acid; clear smooth boundary.

C—42 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium and thick platy structure parting to weak fine subangular blocky; firm; common fine concretions of iron and manganese oxide; medium acid.

The A horizon has value of 3 to 6 and chroma of 2 or 3. The Bt horizon has value of 5 or 6. The content of clay ranges from 48 to 60 percent in the upper 20 inches of this horizon. The C horizon has value of 5 or 6 and chroma of 2 or less.

Menfro Series

The Menfro series consists of deep, well drained soils on uplands adjacent to the flood plains along the Missouri River. These soils formed in loess. Permeability is moderate. Slopes range from 3 to 30 percent.

Typical pedon of Menfro silt loam, 3 to 9 percent slopes, eroded, 6,400 feet east and 2,570 feet north of the southwest corner of sec. 5, T. 45 N., R. 8 W.

Ap—0 to 6 inches; mixed dark brown (10YR 3/3) and dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak very fine granular structure; friable; many very fine and fine roots; medium acid; abrupt smooth boundary.

BE—6 to 12 inches; dark brown (10YR 4/3) silty clay loam; weak very fine subangular blocky structure; friable; common very fine roots; medium acid; clear smooth boundary.

Bt1—12 to 19 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine subangular blocky structure; friable; few very fine roots; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—19 to 31 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; few very fine roots; common faint clay films on faces of peds; few pale brown silt coatings; strongly acid; gradual smooth boundary.

BC—31 to 50 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; few very fine roots; few faint clay films on faces of peds; common pale brown silt coatings; strongly acid; abrupt smooth boundary.

C—50 to 68 inches; yellowish brown (10YR 5/4) silt loam; massive; firm; common pale brown silt coatings; few fine concretions of iron and manganese oxide; medium acid.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The Bt and BC horizons have chroma of 3 or 4.

Mexico Series

The Mexico series consists of deep, somewhat poorly drained soils on uplands. These soils formed in loess and pedisediments. Permeability is very slow. Slopes range from 1 to 5 percent.

Typical pedon of Mexico silt loam, 1 to 5 percent slopes, 1,220 feet west and 720 feet south of the northeast corner of sec. 19, T. 47 N., R. 9 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots; few fine concretions of iron and manganese oxide; neutral; abrupt smooth boundary.

B/E—8 to 10 inches; dark grayish brown (10YR 4/2) and red (2.5YR 4/6) silty clay loam (Bt); moderate very fine subangular structure; friable; brown (10YR 5/3) silt loam (E) occurring as common thick silt coatings on faces of peds and as fillings in vertical cracks; friable; few fine roots; slightly acid; clear smooth boundary.

Bt1—10 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam; many medium prominent dark red (2.5YR 3/6) and few medium prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—14 to 21 inches; dark grayish brown (10YR 4/2) silty clay; common medium faint grayish brown (10YR 5/2), common medium prominent strong brown (7.5YR 5/6), and few fine prominent dark red (2.5YR 3/6) mottles; weak fine subangular blocky structure; firm; few fine roots; few fine concretions of iron and manganese oxide; many faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt3—21 to 26 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/6) and common medium faint light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; firm; few fine roots; few fine concretions of iron and manganese oxide; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

BC—26 to 46 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent dark brown (7.5YR 4/4) and yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; firm; few very fine roots; few fine concretions of iron and manganese oxide; slightly acid; gradual smooth boundary.

2C—46 to 60 inches; light brownish gray (10YR 6/2) clay loam; common medium prominent strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; massive; firm; few fine concretions of iron and manganese oxide; few fine to coarse quartz grains; neutral.

The Ap horizon typically is silt loam, but the range includes silty clay loam.

Moniteau Series

The Moniteau series consists of deep, poorly drained soils on high flood plains. These soils formed in silty alluvium. Permeability is moderately slow. Slopes range from 0 to 3 percent.

Typical pedon of Moniteau silt loam, 0 to 3 percent slopes, 750 feet south and 2,140 feet west of the northeast corner of sec. 8, T. 47 N., R. 9 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine granular structure; friable; common fine roots; common wormcasts; slightly acid; abrupt smooth boundary.

A—6 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine granular structure; friable; common fine roots; common wormcasts; slightly acid; abrupt smooth boundary.

E—9 to 19 inches; grayish brown (10YR 5/2) silt loam; few fine faint dark brown (10YR 4/3) mottles; weak medium and thick platy structure; friable; few fine roots; common visicular pores and wormcasts; few black stains; medium acid; abrupt smooth boundary.

Btg1—19 to 24 inches; dark gray (10YR 4/1) silty clay loam; common medium faint gray (10YR 5/1) and dark grayish brown (10YR 4/2) and few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm; common fine pores; few fine roots; few faint clay films in pores and on faces of peds; few dark stains; very strongly acid; clear smooth boundary.

Btg2—24 to 30 inches; grayish brown (10YR 5/2) silty clay loam; few fine faint gray (10YR 5/1) and dark brown (10YR 4/3) and common medium faint dark grayish brown (10YR 4/2) mottles; weak medium and coarse subangular blocky structure; firm; common fine pores; few light brownish gray (10YR 6/2) skeletans; few distinct clay films on faces of peds and in pores; few black stains; very strongly acid; clear smooth boundary.

Btg3—30 to 37 inches; grayish brown (10YR 5/2) silty clay loam; few fine faint gray (10YR 5/1) and dark brown (10YR 4/3) and common medium faint dark gray (10YR 4/1) mottles; weak very fine subangular blocky structure; firm; common fine pores; few faint clay films on faces of peds and in pores; few light brownish gray (10YR 6/2) skeletans; few black stains and fine concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

Btg4—37 to 56 inches; grayish brown (10YR 5/2) silty clay loam; few fine faint gray (10YR 5/1) and dark brown (10YR 4/3) and common medium faint dark gray (10YR 4/1) mottles; weak very fine subangular blocky structure; firm; few faint clay films on faces of peds; few black stains and fine concretions of iron and manganese oxide; common fine pores; strongly acid; clear smooth boundary.

Cg—56 to 60 inches; gray (10YR 5/1) silty clay loam; common medium faint grayish brown (10YR 5/2) and gray (10YR 6/1) and common medium distinct dark brown (10YR 4/3) mottles; weak very fine subangular blocky structure; firm; common fine pores; few fine concretions of iron and manganese oxide; slightly acid.

The Ap and A horizons have value of 4 or 5 and chroma of 1 or 2. The E horizon has value of 4 to 7 and chroma of 1 or 2. The Btg horizon has value of 4 to 6 and chroma of 1 or 2. The Cg horizon has the same colors as the Btg horizon. It is silt loam or silty clay loam.

Putnam Series

The Putnam series consists of deep, poorly drained soils on uplands. These soils formed in loess. Permeability is very slow. Slopes range from 0 to 2 percent.

Typical pedon of Putnam silt loam, 1,750 feet east and 600 feet north of the southwest corner of sec. 13, T. 47 N., R. 10 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak very fine granular structure; friable; common fine roots; common wormcasts; few black stains; slightly acid; abrupt smooth boundary.

E—7 to 14 inches; grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) silt loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak very fine granular structure; friable; common fine roots; common wormcasts; common fine concretions of iron and manganese oxide; dark reddish brown (2.5YR 3/4) stains along root channels; medium acid; abrupt smooth boundary.

Btg1—14 to 20 inches; dark grayish brown (10YR 4/2) silty clay; few fine faint dark gray (10YR 4/1), common medium prominent dark brown (7.5YR 4/4) and dark reddish brown (5YR 3/4), and few fine prominent red (2.5YR 4/8) mottles; weak very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; few black stains; very strongly acid; clear smooth boundary.

Btg2—20 to 25 inches; dark grayish brown (10YR 4/2) silty clay; few fine faint light brownish gray (10YR 6/2) and grayish brown (10YR 5/2), common medium prominent brown (7.5YR 5/4), and few fine prominent red (2.5YR 4/6) mottles; weak very fine subangular blocky structure; firm; few fine roots; many distinct clay films on faces of peds; few black stains; very strongly acid; clear smooth boundary.

Btg3—25 to 30 inches; grayish brown (2.5Y 5/2) silty clay loam; few medium prominent reddish brown (5YR 4/4) and few fine prominent dark brown (7.5YR 4/4) mottles; weak fine and very fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common fine concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

Btg4—30 to 41 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent reddish brown (5YR 4/4) mottles; weak very fine subangular blocky structure; firm; few very fine pores; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

Cg1—41 to 53 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine faint gray (N 5/0) and light brownish gray (2.5Y 6/2) and few medium prominent reddish brown (5YR 4/4) mottles; massive; firm; few very fine pores; few fine concretions of iron and manganese oxide; medium acid; clear smooth boundary.

Cg2—53 to 60 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; few fine concretions of iron and manganese oxide; medium acid.

The Ap horizon has value and chroma of 2 or 3. The E horizon has value of 5 or 6 and chroma of 1 or 2. The Btg horizon has chroma of 1 or 2.

Snead Series

The Snead series consists of moderately deep, moderately well drained soils on uplands. These soils formed in material weathered from shale thinly interbedded with limestone. Permeability is slow. Slopes range from 9 to 14 percent.

Typical pedon of Snead silty clay loam, 9 to 14 percent slopes, eroded, 2,425 feet west and 2,225 feet south of the northeast corner of sec. 24, T. 49 N., R. 7 W.

Ap—0 to 5 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; many fine roots; neutral; abrupt smooth boundary.

A—5 to 10 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; firm; common fine roots; neutral; clear smooth boundary.

Bw1—10 to 15 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

Bw2—15 to 19 inches; mottled very dark gray (10YR 3/1), yellowish brown (10YR 5/6), and dark grayish brown (2.5Y 4/2) silty clay; weak very fine subangular blocky structure; firm; few fine roots; about 5 percent soft shale fragments; neutral; clear smooth boundary.

BC—19 to 24 inches; mottled dark grayish brown (2.5Y 4/2), yellowish brown (10YR 5/6), very dark gray (10YR 3/1), and strong brown (7.5YR 5/6) silty clay; weak very fine subangular blocky structure; firm; few fine roots; about 5 percent soft shale fragments; neutral; abrupt smooth boundary.

Cr—24 to 60 inches; olive (5Y 5/3), soft, weathered shale bedrock.

The depth to weathered shale bedrock ranges from 24 to 36 inches. The Bw horizon has hue of 10YR or 2.5Y and value of 2 to 5.

Waldron Series

The Waldron series consists of deep, somewhat poorly drained soils on the flood plains along the Missouri River. These soils formed in clayey and loamy alluvium. Permeability is slow. Slopes range from 0 to 2 percent.

The Waldron soils in this county are less calcareous throughout the control section than is definitive for the series. This difference, however, does not significantly affect the use or behavior of the soils.

Typical pedon of Waldron silty clay, loamy substratum, 3,900 feet east and 3,300 feet south of the northwest corner of Survey 2501, T. 44 N., R. 10 W.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular and angular blocky structure; firm; few fine roots; neutral; abrupt smooth boundary.

C1—11 to 19 inches; dark grayish brown (10YR 4/2) silty clay; many medium faint dark brown (10YR 4/3) mottles; appears massive but has weak bedding planes; firm; few very fine roots; very dark gray coatings in root channels; neutral; gradual smooth boundary.

C2—19 to 36 inches; grayish brown (10YR 5/2) silty clay; many medium distinct dark brown (10YR 4/3) mottles; appears massive but has weak bedding planes; firm; few very fine roots; very dark gray coatings in root channels; neutral; clear smooth boundary.

C3—36 to 43 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium distinct dark brown (10YR 4/3) mottles; appears massive but has weak bedding planes; firm; few very fine roots; very dark gray coatings in root channels; neutral; clear smooth boundary.

C4—43 to 48 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct dark brown (10YR 4/3) mottles; massive; firm; neutral; clear smooth boundary.

2C—48 to 75 inches; stratified brown (10YR 4/3 and 5/3) and dark gray (10YR 4/1) very fine sandy loam and silt loam; massive; friable; common very fine pores in the upper part; strong effervescence; mildly alkaline.

The Ap horizon has chroma of 1 or 2. The C horizon has value of 4 or 5 and chroma of 1 or 2. The 2C horizon has chroma of 1 to 3. It is silt loam, very fine sandy loam, or loamy fine sand.

Weingarten Series

The Weingarten series consists of deep, well drained soils on uplands. These soils formed in loess over cherty residuum. Permeability is moderately slow. Slopes range from 5 to 14 percent.

Typical pedon of Weingarten silt loam, 5 to 14 percent slopes, eroded, 660 feet east and 3,150 feet north of the southwest corner of sec. 20, T. 46 N., R. 8 W.

Ap—0 to 6 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak very fine subangular blocky structure; friable; common very fine roots; mixed with yellowish brown (10YR 5/6) material in the lower part; neutral; clear smooth boundary.

Bt1—6 to 16 inches; yellowish brown (10YR 5/6) silty clay loam; weak very fine subangular blocky structure; firm; common very fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; very strongly acid; abrupt smooth boundary.

Bt2—16 to 21 inches; yellowish brown (10YR 5/6) silty clay loam; common medium distinct pale brown (10YR 6/3), few medium distinct brown (10YR 5/3), and few fine distinct strong brown (7.5YR 5/6) mottles, mostly in the lower part; weak very fine subangular blocky structure; firm; common very fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; very strongly acid; abrupt smooth boundary.

Bt3—21 to 28 inches; brown (7.5YR 5/4) silty clay loam; few fine distinct yellowish red (5YR 5/6) mottles; weak very fine subangular blocky structure; firm; common very fine roots; few faint clay films on faces of peds; pale brown (10YR 6/3) and very pale brown (10YR 7/3) silt coatings; dark gray (10YR 4/1) along root channels; very strongly acid; abrupt smooth boundary.

Btx—28 to 43 inches; brown (7.5YR 5/4) silty clay loam; few fine distinct pale brown (10YR 6/3) mottles; moderate medium platy structure parting to weak very fine subangular blocky; firm; brittle in about 25 percent of the matrix; few very fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; few dark gray (10YR 4/1) stains along root channels; few sand grains; strongly acid; abrupt smooth boundary.

2Btb1—43 to 55 inches; reddish brown (5YR 4/4) silty clay loam; common fine distinct brown (7.5YR 5/4) mottles; weak very fine subangular blocky structure; firm; few very fine roots; common faint clay films on faces of peds; few fine black stains and concretions of iron and manganese oxide; few fragments of chert and sandstone; neutral; abrupt smooth boundary.

2Btb2—55 to 65 inches; reddish brown (5YR 4/4) silty clay loam; few fine prominent reddish yellow (7.5YR 6/8) mottles; weak very fine subangular blocky structure; firm; common faint clay films on faces of peds; few fine concretions of iron and manganese oxide; few sand grains; few fragments of chert and sandstone; mildly alkaline.

The Bt horizon has value of 4 or 5. The 2Btb horizon has hue of 7.5YR or 5YR and chroma of 4 to 6. It is silty clay loam or silty clay.

Weller Series

The Weller series consists of deep, moderately well drained soils on uplands. These soils formed in loess. Permeability is slow. Slopes range from 2 to 14 percent.

Typical pedon of Weller silt loam, 2 to 5 percent slopes, 1,100 feet west and 150 feet north of the southeast corner of sec. 36, T. 45 N., R. 11 W.

A—0 to 3 inches; grayish brown (10YR 5/2) silt loam; weak fine granular structure; friable; common fine and very fine roots; neutral; abrupt smooth boundary.

E—3 to 6 inches; brown (10YR 5/3) silt loam; weak fine granular structure; friable; common fine and very fine roots; neutral; abrupt smooth boundary.

BE—6 to 10 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct dark yellowish brown (10YR 4/6) mottles; weak very fine and fine subangular blocky structure; friable; common fine and very fine roots; discontinuous grayish brown (10YR 5/2) silt coatings on faces of peds in the lower part; medium acid; clear smooth boundary.

Bt1—10 to 18 inches; yellowish brown (10YR 5/4) silty clay loam; few fine faint dark brown (10YR 4/3), common fine distinct dark yellowish brown (10YR 4/6), and common medium distinct grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; strongly acid; abrupt smooth boundary.

Bt2—18 to 27 inches; yellowish brown (10YR 5/4) silty clay; common medium prominent yellowish brown (10YR 5/8), few fine prominent strong brown (7.5YR 4/6), and common medium distinct grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt3—27 to 34 inches; light brownish gray (10YR 6/2) silty clay loam; few medium distinct dark yellowish brown (10YR 4/4) and few fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; medium acid; clear smooth boundary.

Bt4—34 to 44 inches; grayish brown (10YR 5/2) silty clay loam; few fine prominent strong brown (7.5YR 4/6) and yellowish brown (10YR 5/6) and few fine distinct dark yellowish brown (10YR 4/4) mottles;

weak fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; medium acid; gradual smooth boundary.

BC—44 to 53 inches; grayish brown (10YR 5/2) silty clay loam; few fine prominent yellowish brown (10YR 5/8), few medium prominent strong brown (7.5YR 4/6), and few medium distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm; medium acid; clear smooth boundary.

C—53 to 60 inches; light brownish gray (10YR 6/2) silt loam; few fine prominent strong brown (7.5YR 4/6), few medium prominent yellowish brown (10YR 5/8), and few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; medium acid.

The A or Ap horizon has chroma of 2 or 3. The E horizon has value of 4 or 5. The lower part of the Bt horizon has value of 5 or 6.

Winfield Series

The Winfield series consists of deep, moderately well drained soils on uplands adjacent to the flood plains along the Missouri River. These soils formed in loess. Permeability is moderate. Slopes range from 3 to 30 percent.

Typical pedon of Winfield silt loam, 3 to 9 percent slopes, eroded, 660 feet west and 1,500 feet north of the southeast corner of sec. 26, T. 46 N., R. 8 W.

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

Bt1—7 to 11 inches; brown (7.5YR 5/4) silty clay loam; weak very fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; medium acid; clear smooth boundary.

Bt2—11 to 18 inches; brown (7.5YR 5/4) silty clay loam; moderate very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; few grayish brown silt coatings on faces of peds; strongly acid; clear smooth boundary.

Bt3—18 to 29 inches; brown (7.5YR 5/4) silty clay loam; few fine distinct strong brown (7.5YR 5/6) and common medium prominent grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; moderate very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; very strongly acid; clear smooth boundary.

Bt4—29 to 36 inches; brown (7.5YR 5/4) and strong brown (7.5YR 5/6) silty clay loam; many medium prominent grayish brown (10YR 5/2) mottles; weak very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; common fine black stains and concretions of iron and manganese oxide; very strongly acid; gradual smooth boundary.

Bt5—36 to 45 inches; dark brown (7.5YR 4/4) and dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; weak very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; common black stains; strongly acid; gradual smooth boundary.

Bt6—45 to 60 inches; dark brown (7.5YR 4/4) and brown (7.5YR 5/4) silt loam; common medium prominent grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; weak very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; common black stains; medium acid.

The Ap horizon has chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6.

Wiota Series

The Wiota series consists of deep, well drained soils on low stream terraces along the tributaries of the Missouri River. These soils formed in silty alluvium. Permeability is moderate. Slopes range from 2 to 5 percent.

Typical pedon of Wiota silt loam, 2 to 5 percent slopes, 1,700 feet east and 2,400 feet north of the southwest corner of sec. 15, T. 44 N., R. 10 W.

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak very fine granular structure; friable; many very fine roots; neutral; abrupt smooth boundary.

A—11 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak very fine granular structure; friable; common very fine roots; few very pale brown (10YR 7/3) silt coatings on faces of peds; neutral; abrupt smooth boundary.

BA—18 to 23 inches; dark brown (10YR 3/3) silty clay loam, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure; firm; few very fine roots; few very pale brown (10YR 7/3) silt coatings on faces of peds; medium acid; abrupt smooth boundary.

Bt1—23 to 27 inches; dark brown (10YR 3/3) silty clay loam, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure; firm; few very fine roots; many distinct clay films on faces of peds; very pale brown (10YR 7/3) silt coatings along some cracks; strongly acid; clear smooth boundary.

Bt2—27 to 36 inches; dark brown (10YR 4/3) silty clay loam; weak very fine subangular blocky structure; firm; few very fine roots; many distinct clay films on faces of peds; very pale brown (10YR 7/3) silt coatings along some cracks; strongly acid; abrupt smooth boundary.

BC—36 to 46 inches; dark brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; firm; very pale brown (10YR 7/3) silt coatings along some cracks; common black stains and concretions of iron and manganese oxide; strongly acid; gradual wavy boundary.

C—46 to 60 inches; dark brown (10YR 4/3) silt loam; many medium prominent yellowish red (5YR 5/8) and many medium faint grayish brown (10YR 5/2) mottles; massive; firm; numerous very pale brown (10YR 7/3) silt coatings in vertical pores and cracks; common black stains and concretions of iron and manganese oxide; strongly acid.

The A horizon has chroma of 1 or 2. It typically is silt loam, but the range includes silty clay loam.

Formation of the Soils

This section relates the major factors of soil formation to the soils in Callaway County. It also describes the geology of the county.

Factors of Soil Formation

Soil forms through processes that act on accumulated or deposited geologic material. The characteristics of the soil at any given location are determined by the physical and mineralogical composition of the parent material, the plant and animal life on and in the soil, the climate under which the soil-forming factors were active, the relief, and the length of time that the forces of soil formation have acted on the soil material.

Callaway County has a great variety of soils, mainly because of variations in parent material and topographic position. These two factors help to determine the duration of weathering and the vegetation. Climate is uniform throughout the county, though it has varied through time. It is responsible for the kinds of soil throughout the county but not for the differences among the soils within the county.

The parent material affects the kind of soil profile that forms and in extreme cases determines it almost entirely. Plant and animal life, chiefly plants, are active in soil formation. Climate determines the amount of water available for leaching and the amount of heat available for physical and chemical changes. Together, climate and plant and animal life act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. Relief commonly modifies the effects of the other factors. Finally, time is required for the transformation of the parent material into a soil. Generally, a long time is required for the development of distinct soil horizons.

The factors of soil formation are so interrelated in their effects on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified for the others.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. The deposition or formation of the parent material is the first step in the development of a soil profile. The characteristics of this material determine the limits of the chemical and mineralogical composition of the soil. The soils in Callaway County formed in four kinds of parent material, alone or in combination. These are residual material weathered from bedrock; loess, or wind-deposited material; glacial till; and alluvium, or water-deposited material.

The county has in four types of residual material. Snead soils formed in material weathered from shale interbedded with thin layers of limestone. Gosport soils formed in shale residuum. Gasconade soils formed in limestone residuum, and Goss soils formed in cherty limestone residuum. Lily soils formed in sandstone residuum.

Loess is wind-transported material. Most likely, the loess was derived mainly from the flood plains along the Missouri River when they were full of sediments borne in meltwater from the last glacier. The loess deposits are deepest in the uplands bordering these flood plains. Menfro and Winfield soils formed on these uplands. As the distance from the source increases, the deposits become thinner and contain more clay. Weller, Putnam, and Mexico soils, which are characterized by restricted drainage, are examples of soils that formed in the finer textured loess on the gentler slopes.

Glacial material was transported by ice. It is made up of clay, silt, sand, gravel, and a few boulders. Much of the glacial till was moved a long distance, although some is of local origin. Armster, Armstrong, Keswick, and Lindley soils formed in glacial till.

Alluvium is material that was transported by water and deposited on nearly level flood plains. Its origins are diverse, and the flowing water that carried the material varies in speed. As a result, this material varies widely in texture and mineralogical composition. The alluvium on the flood plains along small tributary streams is derived from the local uplands. Haymond soils reflect the high silt content of some of the loess-capped uplands, and Landes soils reflect the sand content of the upland soils that formed in glacial till. The vast drainage area of the Missouri River is the source of the parent material in which the soils on the flood plains along the river formed. These soils reflect the varying speed of the flowing water. Grable and Hodge soils formed in material deposited by swiftly flowing water and are coarser textured than Booker, Leta, and Waldron soils, which formed in material deposited in slack-water areas.

Living Organisms

Living organisms in or on the soil are active in the process of soil formation. Plants furnish organic matter to the soil and bring up nutrients from the underlying layers to the surface layer. As these plants die and decay, they contribute organic matter to the soil. Bacteria and fungi decompose the plant remains and help to incorporate the organic matter into the soil.

Native prairie grasses and trees have greatly influenced soil formation in Callaway County. Soils that form under prairie grasses accumulate organic matter mainly through the yearly decomposition of plant material. The tops of the plants decompose at the surface, and the roots decompose at various depths in the soil. As a result, soils that formed under prairie grasses have a thick, dark surface layer. Armster, Armstrong, Booker, Gasconade, Leta, Mexico, Putnam, Snead, Waldron, and Wiota soils are examples.

Soils that form under forest vegetation accumulate organic matter mainly through the decomposition of leaves and twigs on the surface. Consequently, forest soils have a light colored surface layer or a thin, dark surface layer. Gorin, Gosport, Goss, Hatton, Keswick, Lindley, Menfro, Weingarten, Weller, and Winfield soils are examples.

Insects, worms, and animals affect soil formation. Bacteria and fungi are more important than animals. They cause rotting of organic material, fix nitrogen, and improve tilth. Burrowing animals and insects loosen and mix the various soil horizons.

In a short time human activities have greatly affected soil formation in Callaway County. They have caused changes in vegetation and drainage and have accelerated erosion. Row crops have replaced native grasses. Nearly all of the flood plains and many areas on uplands are farmed. Food production has increased, but accelerated erosion continues to reduce the potential of many upland soils. Much cropland has been lost to urban development.

Climate

Climate has been an important factor in soil formation. Geologic erosion, recent accelerated erosion, and plant and animal life have varied with the climate. The current climatic conditions tend to favor the growth of forests rather than prairie grasses. The remaining areas of prairie in Callaway County are the result of a more arid climatic cycle.

The glacial periods that so greatly affected the processes of soil formation were the result of climatic changes. Thousands of years of cold temperatures resulted in the formation of the glaciers that moved into the survey area. Warmer weather and high winds caused severe geologic erosion. Consequently, much of the survey area was covered by loess.

High temperatures and adequate rainfall promote rapid chemical and physical changes. A climate with these characteristics is conducive to the breakdown of minerals and the formation of clay within the soil. The clay is eluviated, or moved downward, in the soil profile, forming a clayey subsoil. Clay has been eluviated in nearly all of the soils on uplands in the county.

Relief

Relief, or lay of the land, affects soil formation through its influence on drainage, runoff, infiltration, and accelerated erosion. Relief consists of the length, shape, aspect, and steepness of the landscape. It is important in determining the pattern and distribution of the soils.

The amount of water that enters the soil depends on the slope, permeability, and the intensity of rainfall. On steep slopes, runoff is rapid, very little water passes through the soil, and soil formation is slow. Geologic erosion nearly keeps pace with the process of soil formation. In gently sloping areas, erosion is minimal, runoff is slow, and most of the water passes through the soil. In these areas, leaching, the translocation of clay, and other soil-forming processes are intensified and the soil is characterized by maximum profile development.

Steep, south-facing slopes receive more direct sunrays and are droughtier than north-facing slopes. Droughtiness influences soil formation through its effect on the kinds of vegetation, erosion, and freezing and thawing.

Time

The degree of profile development depends on the length of time that the parent material has been in place and is subject to the processes of soil formation. The age of a soil is determined by the degree of profile development. It is not simply the number of years that the material has existed. It is the result of the interaction of the processes of soil formation over a period of time. The older soils show the effects of leaching and clay movement. Young soils show little evidence of profile development.

The youngest soils in Callaway County are those that formed in alluvium. Haymond and Landes soils show no evidence of profile development because they receive alluvial material nearly every year. Auxvasse and Wiota soils, which are on stream terraces, are the oldest alluvial soils in the county.

Some of the oldest soils in the county are those that formed in loess and till in the highest positions on the landscape. They have distinct horizons. Armstrong, Mexico, and Putnam soils are examples. Some old soils are on steep side slopes on the lower parts of the landscape. Lindley soils formed in glacial till, and Goss soils formed in cherty limestone residuum. Clay has accumulated in distinct subsoil horizons in these soils, both through weathering and translocation by water.

The moderately sloping to steep Gosport, Snead, and Lily soils formed in shale and sandstone residuum. This residuum is much older than the parent material of the other soils in the county. The removal of material through geological erosion, however, nearly keeps pace with the processes of soil formation. Thus, these soils are considered young.

Geology

Margaret J. Guccione, geologist, University of Arkansas, helped prepare this section.

Callaway County is in an area of diverse geology. Table 19 shows that the age of the bedrock in the county ranges from Ordovician, or 500 million years old, to Pennsylvanian, or 290 million years old *(22)*. The older bedrock units, which are Ordovician to Mississippian, are dominantly shallow marine limestone and dolomite, which include chert lenses and nodules in some areas. Shale and sandstone are less abundant. The older units are exposed in the southern part of the county, along the Missouri River and its tributaries *(3)*. The younger units, which are Pennsylvanian, are deltaic to shallow marine sandstone, shale, clay, limestone, and coal *(7)*. They are in the northern part of the county.

Overlying the bedrock throughout most of the county are unconsolidated continental Quaternary sediments, which are less than 2 million years old. These sediments include glacial till, loess, alluvium, and colluvium. In many areas, the older Quaternary deposits were weathered after deposition and the resulting soils were buried by the younger Quaternary sediments. Most of the modern soils in the county formed in Quaternary deposits.

Prior to glaciation, the oldest Quaternary deposit, the Whippoorwill Formation, was derived from the surrounding bedrock *(6)*. This formation is of limited extent and underlies younger deposits in nearly all areas. Therefore, it is not the parent material of any modern soils in the county.

Glacial deposits of the McCredie Formation overlie the bedrock and the Whippoorwill Formation in Callaway County. At least two pre-Illinoian glaciers covered the central part of Missouri, probably sometime between 2 million and 600,000 years ago. The southern margin of these ice advances was approximately the position of the present Missouri River in this survey area. Each glacier deposited poorly sorted sediments of clay loam called till. The till has boulder- to clay-sized material derived from the areas across which the ice flowed, including Canada, the north-central part of the United States, and the local area. In some areas the older till includes some lenses and irregular bodies of silt, sand, and gravel surrounded by clay loam. In contrast, the younger till is more homogenous clay loam and has few sorted lenses. The younger and older tills can be readily distinguished from one another only in the few areas where intervening deposits or a buried soil separates them.

The till was extensively eroded and weathered during the Yarmouthian Interglacial Stage and the Illinoian Glaciation, approximately 600,000 to 135,000 years ago. The only uneroded areas of the soils that formed during this interval are on the broad, nearly level upland divides. In these areas the deep, somewhat poorly drained Yarmouth Soil formed in till and underlies younger sediments.

Wind-blown material, or loess, was derived from the flood plains along the Missouri River. It was deposited during three major periods, burying the Yarmouth Soil. The oldest loess is Loveland Silt, which was deposited more than 125,000 years ago. The intermediate loess is Roxana Silt, which was deposited sometime between 125,000 and 28,000 years ago. It is a thin deposit and cannot be easily identified throughout most of the county. The youngest and thickest loess is Peoria Loess, which was deposited sometime between 22,000 and 14,000 years ago. All three kinds of loess are similar and cannot be readily distinguished from one another unless they are separated by intervening soils. If only one kind of loess is in a given area, it is likely to be Peoria Loess. Typically, loess deposits are thickest and coarsest textured adjacent to their source. They are thinner and finer textured in the areas farther from the Missouri River.

The interval between the deposition of Loveland Silt and Peoria Loess includes the Sangamonian Interglacial Stage and much of the Wisconsinan Glaciation. During this time, the landscape in Missouri continued to be modified. The broad divides were stable areas, the narrow divides and slopes were eroded, streams deposited alluvium on the flood plains, and both the erosional and depositional surfaces were weathered.

Deep, somewhat poorly drained soils formed on the highest broad primary divides several miles from the Missouri River. They weathered through the Loveland Silt deposited during the early Sangamonian Stage and into the underlying Yarmouth Soil that formed in till. These well developed composite soils are known as the Yarmouth-early Sangamon Soils. Water erosion removed the Loveland Silt and the Yarmouth-early Sangamon Soils from the slopes in the more extensively dissected areas.

The lower secondary divides and the adjacent upper side slopes are somewhat eroded. Moderately deep, somewhat poorly drained or moderately well drained soils formed in valley alluvium. These moderately developed soils are termed the middle Sangamon Soil.

The narrowest and lowest tertiary divides and the adjacent steep slopes were severely eroded. The late Sangamon Soil formed in the exposed till. This soil is weakly developed, shallow, and moderately well drained. Similar soils formed in the colluvium periodically deposited along the lower slopes. The dissected areas of the early, middle, and late stages of the Sangamon Soil formed in loess, till, alluvium, and colluvium and were buried by Roxana Silt and Peoria Loess during the Wisconsinan Glaciation.

During the past 14,000 years, the uplands have been changed mainly by erosion and the valleys mainly by deposition. The primary divides are relatively stable, but erosion occurs on the lower secondary and tertiary divides and on the slopes. Downcutting has occurred in the valleys, leaving high terraces covered by Peoria Loess. Colluvium is deposited on the lower slopes. Alluvium is deposited in the valleys. It forms the low terraces and the present flood plains. The maximum relief in the county is about 400 feet. Weathering occurs on the erosional surfaces, exposing older deposits and buried soils, and on the depositional surfaces overlying loess, colluvium, and alluvium.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in the production of crops. In areas where a sprinkler irrigation system is used, water is sprayed over the surface through pipes or nozzles from a pressure system.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediments of variable thickness.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-81 at Fulton, Missouri)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	36.8	16.7	26.8	69	-10	0	1.41	0.56	2.12	4	5.2
February----	42.1	20.8	31.5	73	-5	8	1.65	.72	2.44	4	5.6
March-------	51.9	29.5	40.7	83	5	49	2.85	1.43	4.07	6	4.3
April-------	65.9	42.8	54.4	88	24	180	3.56	2.24	4.74	7	.5
May---------	74.8	51.9	63.4	90	33	422	4.37	2.90	5.70	8	.0
June--------	83.9	61.3	72.6	97	46	678	3.74	1.75	5.45	7	.0
July--------	89.1	66.0	77.6	102	51	856	3.97	1.58	5.98	7	.0
August------	87.9	63.7	75.8	102	50	800	2.84	1.18	4.23	5	.0
September---	81.5	55.9	68.7	97	39	561	3.47	1.19	5.34	5	.0
October-----	69.3	43.8	56.6	91	25	243	3.27	1.15	5.02	5	.0
November----	54.3	32.2	43.3	79	10	29	2.28	.98	3.38	4	1.6
December----	41.7	22.5	32.1	70	-4	0	1.97	.83	2.93	5	4.2
Yearly:											
Average---	64.9	42.3	53.6	---	---	---	---	---	---	---	---
Extreme---	---	---	---	105	-11	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,826	35.38	27.62	42.20	67	21.4

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-81 at Fulton, Missouri)

Probability	Temperature 24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 9	Apr. 20	Apr. 30
2 years in 10 later than--	Apr. 5	Apr. 16	Apr. 25
5 years in 10 later than--	Mar. 27	Apr. 6	Apr. 16
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 20	Oct. 15	Oct. 8
2 years in 10 earlier than--	Oct. 26	Oct. 20	Oct. 13
5 years in 10 earlier than--	Nov. 5	Oct. 30	Oct. 21

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-81 at Fulton, Missouri)

Probability	Daily minimum temperature during growing season: Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	201	184	169
8 years in 10	208	191	176
5 years in 10	222	206	188
2 years in 10	235	220	200
1 year in 10	242	227	206

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
9C2	Armster loam, 5 to 9 percent slopes, eroded	2,500	0.5
9D2	Armster loam, 9 to 14 percent slopes, eroded	430	0.1
10C2	Armstrong loam, 5 to 9 percent slopes, eroded	12,900	2.4
10D2	Armstrong loam, 9 to 14 percent slopes, eroded	560	0.1
13A	Auxvasse silt loam, 0 to 3 percent slopes	1,050	0.2
15B	Calwoods silt loam, 2 to 5 percent slopes	9,200	1.7
15B2	Calwoods silt loam, 2 to 5 percent slopes, eroded	12,000	2.2
16C2	Crider silt loam, 5 to 9 percent slopes, eroded	520	0.1
16D2	Crider silt loam, 9 to 14 percent slopes, eroded	300	0.1
18F	Goss-Gasconade-Rock outcrop complex, 5 to 35 percent slopes	90,500	16.7
19C	Gorin silt loam, 3 to 9 percent slopes	6,200	1.1
19C2	Gorin silt loam, 3 to 9 percent slopes, eroded	18,900	3.5
20D	Goss cherty silt loam, 9 to 14 percent slopes	3,500	0.6
21C	Hatton silt loam, 3 to 9 percent slopes	3,100	0.6
21C2	Hatton silt loam, 3 to 9 percent slopes, eroded	5,000	0.9
22C2	Keswick loam, 5 to 9 percent slopes, eroded	84,000	15.5
22D2	Keswick loam, 9 to 14 percent slopes, eroded	8,200	1.5
24D	Lindley loam, 9 to 14 percent slopes	5,100	0.9
24D2	Lindley clay loam, 9 to 14 percent slopes, eroded	14,800	2.7
24F	Lindley loam, 14 to 30 percent slopes	27,250	5.0
25	Marion silt loam	510	0.1
27B	Mexico silt loam, 1 to 5 percent slopes	28,000	5.2
27B2	Mexico silt loam, 1 to 5 percent slopes, eroded	53,500	9.9
28A	Moniteau silt loam, 0 to 3 percent slopes	7,300	1.3
29	Landes loam	10,800	2.0
31	Haymond silt loam	9,400	1.7
32	Cedargap loam	6,900	1.3
33	Belknap silt loam	6,300	1.2
34	Putnam silt loam	8,700	1.6
35C2	Winfield silt loam, 3 to 9 percent slopes, eroded	8,600	1.6
35D2	Winfield silt loam, 9 to 14 percent slopes, eroded	6,600	1.2
35E2	Winfield silt loam, 14 to 20 percent slopes, eroded	5,800	1.1
35F2	Winfield silt loam, 20 to 30 percent slopes, eroded	9,100	1.7
37C2	Menfro silt loam, 3 to 9 percent slopes, eroded	1,050	0.2
37D2	Menfro silt loam, 9 to 14 percent slopes, eroded	485	0.1
37E2	Menfro silt loam, 14 to 20 percent slopes, eroded	580	0.1
37F2	Menfro silt loam, 20 to 30 percent slopes, eroded	2,450	0.5
39	Hodge fine sand, loamy substratum	1,300	0.2
40	Grable very fine sandy loam, loamy substratum	7,700	1.4
41	Leta silty clay loam, sandy substratum	5,300	1.0
42	Waldron silty clay, loamy substratum	6,900	1.3
43	Booker silty clay	3,600	0.7
44	Dupo silt loam	950	0.2
45C	Freeburg silt loam, 3 to 9 percent slopes	3,500	0.6
49D	Armster cobbly loam, 5 to 14 percent slopes	4,450	0.8
49F	Armster cobbly loam, 14 to 30 percent slopes	970	0.2
56B	Weller silt loam, 2 to 5 percent slopes	3,400	0.6
56C2	Weller silt loam, 5 to 9 percent slopes, eroded	8,400	1.5
56D2	Weller silt loam, 9 to 14 percent slopes, eroded	1,100	0.2
60D2	Weingarten silt loam, 5 to 14 percent slopes, eroded	3,900	0.7
64F	Lily-Winfield-Rock outcrop complex, 5 to 35 percent slopes	610	0.1
73F	Gosport silt loam, 5 to 30 percent slopes	300	*
74D2	Snead silty clay loam, 9 to 14 percent slopes, eroded	530	0.1
80C	Winfield silt loam, bench, 3 to 9 percent slopes	3,050	0.6
83C	Weller silt loam, bench, 3 to 9 percent slopes	4,400	0.8
87B	Wiota silt loam, 2 to 5 percent slopes	640	0.1
98F	Bethesda-Dumps complex, 5 to 60 percent slopes	2,950	0.5
99	Pits, quarries	520	0.1
	Water areas more than 40 acres in size	3,652	0.5
	Water areas less than 40 acres in size	2,148	0.6
	Total	542,355	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
13A	Auxvasse silt loam, 0 to 3 percent slopes (where drained)
15B	Calwoods silt loam, 2 to 5 percent slopes (where drained)
15B2	Calwoods silt loam, 2 to 5 percent slopes, eroded (where drained)
25	Marion silt loam
27B	Mexico silt loam, 1 to 5 percent slopes (where drained)
27B2	Mexico silt loam, 1 to 5 percent slopes, eroded (where drained)
28A	Moniteau silt loam, 0 to 3 percent slopes (where drained)
29	Landes loam (where protected from flooding or not frequently flooded during the growing season)
31	Haymond silt loam
32	Cedargap loam (where protected from flooding or not frequently flooded during the growing season)
33	Belknap silt loam (where drained)
34	Putnam silt loam (where drained)
40	Grable very fine sandy loam, loamy substratum
41	Leta silty clay loam, sandy substratum
42	Waldron silty clay, loamy substratum (where drained)
43	Booker silty clay (where drained)
44	Dupo silt loam
56B	Weller silt loam, 2 to 5 percent slopes
87B	Wiota silt loam, 2 to 5 percent slopes

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Tall fescue-red clover hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	AUM*
9C2------------- Armster	IIIe	89	33	78	36	3.3	6.5
9D2------------- Armster	IVe	79	29	68	31	2.8	5.6
10C2------------ Armstrong	IIIe	85	31	72	34	3.1	6.2
10D2------------ Armstrong	IVe	70	25	59	27	2.5	5.0
13A------------- Auxvasse	IIIw	88	34	80	37	3.5	7.0
15B------------- Calwoods	IIe	88	34	80	37	3.5	7.0
15B2------------ Calwoods	IIIe	86	31	75	35	3.0	6.0
16C2------------ Crider	IIIe	95	35	83	38	3.5	7.0
16D2------------ Crider	IIIe	85	31	72	34	3.1	6.2
18F**----------- Goss-Gasconade-Rock outcrop	VIIe	---	---	---	---	---	1.0
19C------------- Gorin	IIIe	83	31	72	34	3.1	6.2
19C2------------ Gorin	IIIe	78	29	68	31	2.8	5.5
20D------------- Goss	VIe	---	---	---	---	---	3.5
21C------------- Hatton	IIIe	67	25	59	27	2.5	5.0
21C2------------ Hatton	IIIe	59	21	53	25	2.3	4.5
22C2------------ Keswick	IIIe	85	31	72	34	3.1	6.2
22D2------------ Keswick	IVe	70	25	59	27	2.5	5.0
24D------------- Lindley	IVe	86	31	76	35	3.1	6.2
24D2------------ Lindley	IVe	81	30	71	33	3.0	5.9

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Tall fescue-red clover hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	AUM*
24F------------- Lindley	VIIe	---	---	---	---	---	5.0
25-------------- Marion	IIIw	88	32	77	36	3.3	6.5
27B------------- Mexico	IIe	96	36	85	39	3.8	7.5
27B2------------ Mexico	IIIe	88	34	80	37	3.5	7.0
28A------------- Moniteau	IIIw	101	37	88	41	3.8	7.4
29-------------- Landes	IIIw	97	29	68	31	2.8	5.6
31-------------- Haymond	IIw	110	39	92	42	4.0	8.0
32-------------- Cedargap	IIIw	60	20	50	24	2.2	4.4
33-------------- Belknap	IIw	118	44	105	48	4.4	8.8
34-------------- Putnam	IIw	96	36	85	39	3.8	7.2
35C2------------ Winfield	IIIe	102	37	89	41	3.8	7.5
35D2------------ Winfield	IIIe	88	34	80	37	3.5	7.0
35E2------------ Winfield	IVe	82	32	75	35	3.1	6.2
35F2------------ Winfield	VIe	---	---	---	---	2.8	5.6
37C2------------ Menfro	IIIe	94	35	83	38	3.5	7.0
37D2------------ Menfro	IIIe	82	30	72	33	3.0	6.0
37E2------------ Menfro	IVe	74	27	65	30	2.8	5.6
37F2------------ Menfro	VIe	---	---	---	---	2.5	5.0
39-------------- Hodge	IIIw	38	15	35	25	2.2	4.4
40-------------- Grable	IIs	96	36	85	39	3.8	7.2

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Tall fescue-red clover hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	AUM*
41-------------- Leta	IIw	108	40	94	44	4.0	8.0
42-------------- Waldron	IIw	96	35	85	38	3.5	7.0
43-------------- Booker	IIIw	86	31	75	34	3.0	6.0
44-------------- Dupo	IIw	123	47	110	51	4.6	9.1
45C------------- Freeburg	IIIe	110	40	95	45	4.0	8.0
49D------------- Armster	IVe	---	---	---	---	2.8	5.6
49F------------- Armster	VIe	---	---	---	---	2.0	4.0
56B------------- Weller	IIIe	96	35	85	38	3.6	7.2
56C2------------ Weller	IIIe	85	31	73	34	3.0	6.0
56D2------------ Weller	IVe	72	25	63	28	2.6	5.2
60D2------------ Weingarten	IVe	60	20	50	25	2.3	4.5
64F**----------- Lily-Winfield-Rock outcrop	VIe	---	---	---	---	---	3.2
73F------------- Gosport	VIIe	---	---	---	---	1.5	3.0
74D2------------ Snead	VIe	---	---	---	---	2.1	4.2
80C------------- Winfield	IIIe	108	40	94	44	4.0	8.0
83C------------- Weller	IIIe	90	34	78	36	3.3	6.6
87B------------- Wiota	IIe	118	44	103	48	4.3	8.5
98F**----------- Bethesda-Dumps	VIIe	---	---	---	---	---	1.0
99**. Pits							

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordi-nation symbol	Management concerns: Erosion hazard	Management concerns: Equip-ment limita-tion	Management concerns: Seedling mortal-ity	Management concerns: Wind-throw hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
9C2, 9D2: Armster	4A	Slight	Slight	Slight	Slight	Pin oak	70	52	Pin oak, white ash, northern red oak, white oak, black oak.
10C2, 10D2: Armstrong	3C	Slight	Slight	Moderate	Severe	White oak	55	38	Eastern white pine, red pine.
						Northern red oak	55	38	
13A: Auxvasse	4W	Slight	Severe	Moderate	Severe	Pin oak	76	58	Pin oak, white oak, green ash, eastern cottonwood, silver maple, sweetgum.
						Silver maple	---	---	
						Green ash	---	---	
15B, 15B2: Calwoods	3C	Slight	Slight	Moderate	Severe	White oak	55	38	White oak, pin oak, white ash, black oak.
16C2, 16D2: Crider	3A	Slight	Slight	Slight	Slight	White oak	66	48	Eastern white pine, black walnut, white ash.
						Northern red oak	70	52	
						Black oak	---	---	
18F**:									
Goss	3R	Moderate	Moderate	Slight	Slight	White oak	60	43	White oak, yellow poplar, white ash.
						Post oak	---	---	
						Blackjack oak	---	---	
						Black oak	---	---	
Gasconade	2R	Moderate	Moderate	Severe	Severe	Chinkapin oak	40	26	
						Eastern redcedar	30	32	
						White ash	---	---	
						Sugar maple	---	---	
						Mockernut hickory	---	---	
						Post oak	---	---	
						Blackjack oak	---	---	
Rock outcrop.									
19C, 19C2: Gorin	3C	Slight	Slight	Moderate	Severe	White oak	55	38	White oak, white ash, pin oak, black oak.
20D: Goss	3A	Slight	Slight	Slight	Slight	White oak	60	43	Yellow poplar, white ash, northern red oak.
						Post oak	---	---	
						Blackjack oak	---	---	
						Black oak	---	---	

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
21C, 21C2------- Hatton	3C	Slight	Slight	Moderate	Moderate	White oak-----------	56	39	White oak, black oak, white ash.
22C2, 22D2------ Keswick	3C	Slight	Slight	Moderate	Severe	White oak----------- Northern red oak----	55 55	38 38	Eastern white pine, northern red oak, sugar maple.
24D, 24D2------- Lindley	3A	Slight	Slight	Slight	Slight	White oak----------- Post oak------------ Blackjack oak------- Black oak----------- White oak----------- Post oak------------	60 --- --- --- --- ---	43 --- --- --- --- ---	White oak, white ash, black oak, northern red oak.
24F------------- Lindley	3R	Moderate	Moderate	Slight	Slight	White oak----------- Post oak------------ Blackjack oak------- Black oak----------- White oak----------- Post oak------------	60 --- --- --- --- ---	43 --- --- --- --- ---	White oak, white ash, black oak, northern red oak.
25-------------- Marion	2W	Slight	Severe	Moderate	Severe	White oak----------- Post oak------------	50 ---	34 ---	White oak, pin oak, white ash.
28A------------- Moniteau	4W	Slight	Severe	Moderate	Moderate	Pin oak-------------	70	52	White oak, pin oak, white ash, eastern cottonwood, silver maple.
29-------------- Landes	10A	Slight	Slight	Slight	Slight	Eastern cottonwood-- American sycamore--- Green ash-----------	105 --- ---	141 --- ---	Eastern cottonwood, yellow poplar, American sycamore, green ash, black walnut.
31-------------- Haymond	9A	Slight	Slight	Slight	Slight	Eastern cottonwood-- White oak----------- Black walnut--------	100 90 70	128 72 ---	Eastern white pine, black walnut, white oak.
32-------------- Cedargap	3A	Slight	Slight	Slight	Slight	Black oak-----------	66	48	Black oak.
33-------------- Belknap	6A	Slight	Slight	Slight	Slight	Eastern cottonwood-- American sycamore--- Pin oak-------------	100 --- 90	128 --- 72	Eastern cottonwood, American sycamore.

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
35C2, 35D2 Winfield	3A	Slight	Slight	Slight	Slight	White oak	65	48	Eastern white pine, white ash, yellow poplar, northern red oak, black oak.
						Northern red oak	60	48	
						Black oak	65	48	
35E2, 35F2 Winfield	3R	Moderate	Moderate	Slight	Slight	White oak	65	48	Eastern white pine, white ash, yellow poplar, northern red oak, black oak.
						Northern red oak	60	48	
						Black oak	65	48	
37C2, 37D2 Menfro	3A	Slight	Slight	Slight	Slight	White oak	65	48	White ash, black walnut, yellow poplar, white oak, eastern white pine.
						Northern red oak	75	48	
						Black oak	73	48	
						White ash	70	48	
						Sugar maple	68	48	
37E2, 37F2 Menfro	3R	Moderate	Moderate	Slight	Slight	White oak	65	48	White ash, black walnut, yellow poplar, white oak, eastern white pine.
						Northern red oak	75	57	
						Black oak	73	55	
						White ash	70	66	
						Sugar maple	68	43	
39 Hodge	13S	Slight	Moderate	Moderate	Slight	Eastern cottonwood	120	186	Eastern cottonwood, silver maple, green ash.
						Silver maple	105	56	
41 Leta	7C	Slight	Moderate	Slight	Slight	Eastern cottonwood	90	103	Pecan, eastern cottonwood, silver maple, green ash.
						Silver maple	85	38	
						Black willow	---	---	
42 Waldron	4C	Slight	Severe	Severe	Slight	Pin oak	80	62	Pin oak, pecan, eastern cottonwood, green ash, silver maple.
						Eastern cottonwood	110	156	
43 Booker	6W	Slight	Severe	Severe	Severe	Eastern cottonwood	85	91	Eastern cottonwood, pin oak, pecan, green ash, silver maple.
						Silver maple	80	34	
45C Freeburg	3A	Slight	Slight	Slight	Slight	White oak	65	48	White oak, white ash, eastern cottonwood, yellow poplar, black oak.

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
49D------------- Armster	4A	Slight	Slight	Slight	Slight	Pin oak-------------	70	52	White ash, northern red oak, white oak, black oak.
49F------------- Armster	4R	Moderate	Moderate	Slight	Slight	Pin oak-------------	70	52	White ash, northern red oak, white oak, black oak.
56B, 56C2, 56D2- Weller	3C	Slight	Slight	Moderate	Severe	White oak-----------	55	38	Eastern white pine, black oak.
60D2------------ Weingarten	4A	Slight	Slight	Slight	Slight	Northern red oak---- White oak----------- Black oak-----------	70 66 ---	52 48 ---	Black oak, northern red oak, yellow poplar.
64F**:									
Lily-----------	3R	Moderate	Moderate	Slight	Slight	Black oak----------- Post oak------------ White ash----------- Northern red oak---- White oak-----------	58 --- --- 54 ---	41 --- --- 38 ---	White ash, northern red oak, black oak.
Winfield-------	3R	Moderate	Moderate	Slight	Slight	White oak----------- Northern red oak---- Black oak-----------	65 60 65	48 48 48	Eastern white pine, white ash, yellow poplar, northern red oak, black oak.
Rock outcrop.									
73F------------- Gosport	2R	Moderate	Moderate	Severe	Severe	White oak-----------	45	30	Eastern white pine, black oak.
74D2------------ Snead	3D	Slight	Slight	Severe	Severe	Northern red oak---- White oak----------- White ash----------- Sugar maple---------	62 55 56 ---	45 38 44 ---	Northern red oak, white ash.
80C------------- Winfield	3A	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Black oak-----------	65 60 65	48 48 48	Eastern white pine, white ash, yellow poplar, northern red oak, black oak.
83C------------- Weller	3C	Slight	Slight	Severe	Severe	White oak-----------	55	38	Eastern white pine, black walnut.

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
98F**:									
Bethesda	---	--------	--------	--------	--------		---	---	Eastern white pine, eastern cottonwood, river birch.
Dumps.									

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
9C2, 9D2 Armster	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
10C2, 10D2 Armstrong	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush, Amur honeysuckle.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
13A. Auxvasse					
15B, 15B2 Calwoods	---	Amur honeysuckle, Amur privet, eastern redcedar, Washington hawthorn, arrowwood, American cranberrybush.	Austrian pine, Osageorange, green ash.	Pin oak, eastern white pine.	---
16C2, 16D2 Crider	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, blue spruce, northern whitecedar, white fir.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.
18F*: Goss	Siberian peashrub	Lilac, Amur honeysuckle, autumn olive, eastern redcedar, Washington hawthorn, radiant crabapple.	Austrian pine, eastern white pine, jack pine, red pine.	---	---
Gasconade.					
Rock outcrop.					
19C, 19C2 Gorin	---	Amur honeysuckle, Washington hawthorn, eastern redcedar, Amur privet, arrowwood, American cranberrybush.	Green ash, Austrian pine, Osageorange.	Pine oak, eastern white pine.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
20D---------------- Goss	Siberian peashrub	Lilac, Amur honeysuckle, autumn olive, eastern redcedar, Washington hawthorn, radiant crabapple.	Austrian pine, eastern white pine, jack pine, red pine.	---	---
21C, 21C2--------- Hatton	---	Amur honeysuckle, American cranberrybush, eastern redcedar, Amur privet, arrowwood, Washington hawthorn.	Austrian pine, Osageorange, green ash.	Eastern white pine, pin oak.	---
22C2, 22D2-------- Keswick	---	Eastern redcedar, American cranberrybush, Washington hawthorn, arrowwood, Amur privet, Amur honeysuckle.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
24D, 24D2, 24F---- Lindley	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern whitecedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
25---------------- Marion	---	Amur honeysuckle, American cranberrybush, Amur privet, eastern redcedar, Washington hawthorn, arrowwood.	Austrian pine, Osageorange, green ash.	Eastern white pine, pin oak.	---
27B, 27B2--------- Mexico	---	Amur honeysuckle, American cranberrybush, arrowwood, eastern redcedar, Amur privet, Washington hawthorn.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
28A--------------- Moniteau	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
29---------------- Landes	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
31---------------- Haymond	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
32---------------- Cedargap	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Austrian pine, northern whitecedar, white fir, Washington hawthorn, blue spruce.	Norway spruce-----	Eastern white pine, pin oak.
33---------------- Belknap	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Pin oak, eastern white pine.
34---------------- Putnam	---	American cranberrybush, Amur honeysuckle, Amur privet, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
35C2, 35D2, 35E2, 35F2------------- Winfield	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	Northern whitecedar, blue spruce, white fir, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
37C2, 37D2, 37E2, 37F2------------- Menfro	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Northern whitecedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
39---------------- Hodge	---	Siberian peashrub	Osageorange, northern whitecedar, eastern redcedar, nannyberry viburnum, green ash, white spruce, Washington hawthorn.	Black willow, golden willow.	Eastern cottonwood.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
40 Grable	---	Siberian peashrub	Nannyberry viburnum, Washington hawthorn, white spruce, northern whitecedar, eastern redcedar, green ash.	Black willow, golden willow.	Eastern cottonwood.
41 Leta	---	Siberian peashrub	Green ash, Osageorange, eastern redcedar, northern whitecedar, white spruce, nannyberry viburnum, Washington hawthorn.	Black willow, golden willow.	Eastern cottonwood.
42 Waldron	---	Siberian peashrub	Washington hawthorn, nannyberry viburnum, eastern redcedar, white spruce, northern whitecedar, green ash, Osageorange.	Golden willow, black willow.	Eastern cottonwood.
43 Booker	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
44 Dupo	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
45C Freeburg	---	American cranberrybush, Amur honeysuckle, silky dogwood, Amur privet.	Northern whitecedar, white fir, blue spruce, Washington hawthorn, northern whitecedar.	Norway spruce	Eastern white pine, pin oak.
49D, 49F Armster	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Blue spruce, white fir, Washington hawthorn, northern whitecedar.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
56B, 56C2, 56D2---Weller	---	American cranberrybush, Amur honeysuckle, arrowwood, Washington hawthorn, Amur privet, eastern redcedar.	Osageorange, green ash, Austrian pine.	Eastern white pine, pin oak.	---
60D2---Weingarten	---	Lilac, Amur honeysuckle, Amur maple, autumn olive.	Russian olive, hackberry, eastern redcedar.	Honeylocust, Norway spruce, green ash, pin oak, eastern white pine.	---
64F*:					
Lily.					
Winfield----	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	Northern whitecedar, blue spruce, white fir, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
Rock outcrop.					
73F---Gosport	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
74D2---Snead	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Bur oak, Austrian pine, green ash, Osageorange.	Eastern white pine	---
80C---Winfield	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	Northern whitecedar, blue spruce, white fir, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
83C---Weller	---	American cranberrybush, Amur honeysuckle, arrowwood, Washington hawthorn, Amur privet, eastern redcedar.	Osageorange, green ash, Austrian pine.	Eastern white pine, pin oak.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
87B---------------- Wiota	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce,	Eastern white pine, pin oak.
98F*:					
Bethesda.					
Dumps.					
99*. Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
9C2 Armster	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Slight.
9D2 Armster	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
10C2 Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
10D2 Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
13A Auxvasse	Severe: flooding, wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
15B, 15B2 Calwoods	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
16C2 Crider	Slight	Slight	Severe: slope.	Slight	Slight.
16D2 Crider	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
18F*:					
Goss	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: droughty, slope.
Gasconade	Severe: slope, thin layer.	Severe: slope, thin layer.	Severe: large stones, slope, thin layer.	Moderate: large stones, slope.	Severe: large stones, slope, thin layer.
Rock outcrop.					
19C, 19C2 Gorin	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight	Slight.
20D Goss	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight	Severe: droughty.
21C, 21C2 Hatton	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
22C2 Keswick	Severe: wetness.	Moderate: wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
22D2 Keswick	Severe: wetness.	Moderate: slope, wetness.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
24D, 24D2 Lindley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
24F Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
25 Marion	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
27B, 27B2 Mexico	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
28A Moniteau	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
29 Landes	Severe: flooding.	Moderate: flooding.	Slight	Moderate: flooding.	Severe: flooding.
31 Haymond	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
32 Cedargap	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
33 Belknap	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
34 Putnam	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
35C2 Winfield	Slight	Slight	Severe: slope.	Slight	Slight.
35D2 Winfield	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
35E2 Winfield	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
35F2 Winfield	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
37C2 Menfro	Slight	Slight	Severe: slope.	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
37D2 Menfro	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
37E2 Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
37F2 Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
39 Hodge	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy, flooding.	Severe: too sandy.	Severe: flooding.
40 Grable	Severe: flooding.	Slight	Slight	Slight	Slight.
41 Leta	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
42 Waldron	Severe: flooding, wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
43 Booker	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
44 Dupo	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
45C Freeburg	Severe: flooding.	Moderate: wetness, percs slowly.	Severe: slope.	Moderate: wetness.	Moderate: wetness.
49D Armster	Moderate: slope, large stones, percs slowly.	Moderate: slope, large stones, percs slowly.	Severe: large stones, slope.	Moderate: large stones.	Severe: large stones.
49F Armster	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Moderate: large stones, slope.	Severe: large stones, slope.
56B Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
56C2 Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight	Slight.
56D2 Weller	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
60D2------------------ Weingarten	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
64F*:					
Lily-----------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Winfield-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Rock outcrop.					
73F------------------ Gosport	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
74D2----------------- Snead	Moderate: slope, wetness.	Moderate: slope, wetness.	Severe: slope.	Severe: erodes easily.	Moderate: large stones, slope.
80C------------------ Winfield	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
83C------------------ Weller	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
87B------------------ Wiota	Severe: flooding.	Slight----------	Moderate: slope.	Slight----------	Slight.
98F*:					
Bethesda-------------	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: droughty, slope.
Dumps.					
99*. Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
9C2, 9D2 Armster	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
10C2, 10D2 Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
13A Auxvasse	Fair	Good	Poor	Good	Good	Good	Fair	Fair	Good	Fair.
15B, 15B2 Calwoods	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
16C2, 16D2 Crider	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
18F*:										
Goss	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Gasconade	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Rock outcrop.										
19C, 19C2 Gorin	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
20D Goss	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
21C, 21C2 Hatton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
22C2, 22D2 Keswick	Fair	Good	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
24D, 24D2 Lindley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
24F Lindley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
25 Marion	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
27B, 27B2 Mexico	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
28A Moniteau	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
29 Landes	Poor	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
31 Haymond	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
32----------------- Cedargap	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
33----------------- Belknap	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
34----------------- Putnam	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
35C2, 35D2--------- Winfield	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
35E2--------------- Winfield	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
35F2--------------- Winfield	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
37C2, 37D2--------- Menfro	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
37E2--------------- Menfro	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
37F2--------------- Menfro	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
39----------------- Hodge	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
40----------------- Grable	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
41----------------- Leta	Fair	Fair	Poor	Good	Good	Poor	Fair	Fair	Fair	Poor.
42----------------- Waldron	Fair	Fair	Fair	Good	Good	Poor	Fair	Fair	Fair	Poor.
43----------------- Booker	Poor	Poor	Fair	Poor	Poor	Poor	Good	Poor	Poor	Fair.
44----------------- Dupo	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
45C---------------- Freeburg	Fair	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Fair.
49D---------------- Armster	Poor	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Fair	Poor.
49F---------------- Armster	Poor	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
56B---------------- Weller	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Poor.
56C2, 56D2--------- Weller	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
60D2----------------Weingarten	Fair	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.
64F*:										
Lily----------------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Winfield----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Rock outcrop.										
73F----------------Gosport	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
74D2----------------Snead	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
80C----------------Winfield	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
83C----------------Weller	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
87B----------------Wiota	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Poor.
98F*:										
Bethesda----------	Very poor.	Very poor.	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.
Dumps.										
99*. Pits										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
9C2---------------- Armster	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
9D2---------------- Armster	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
10C2--------------- Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength.	Moderate: wetness.
10D2--------------- Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: slope, wetness.
13A---------------- Auxvasse	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
15B, 15B2---------- Calwoods	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
16C2--------------- Crider	Moderate: too clayey.	Slight---------	Slight---------	Moderate: slope.	Severe: low strength, frost action.	Slight.
16D2--------------- Crider	Moderate: too clayey, slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
18F*:						
Goss--------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Gasconade---------	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones, slope, thin layer.
Rock outcrop.						
19C, 19C2---------- Gorin	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
20D----- Goss	Moderate: too clayey, large stones, slope.	Moderate: shrink-swell, slope, large stones.	Moderate: slope, shrink-swell, large stones.	Severe: slope.	Moderate: shrink-swell, slope, frost action.	Severe: droughty.
21C, 21C2----- Hatton	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Slight.
22C2----- Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
22D2----- Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
24D, 24D2----- Lindley	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
24F----- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
25----- Marion	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
27B, 27B2----- Mexico	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
28A----- Moniteau	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
29----- Landes	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
31----- Haymond	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.	Moderate: flooding.
32----- Cedargap	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
33----- Belknap	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: wetness, flooding.
34----- Putnam	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
35C2-------------- Winfield	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
35D2-------------- Winfield	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
35E2, 35F2-------- Winfield	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
37C2-------------- Menfro	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
37D2-------------- Menfro	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
37E2, 37F2-------- Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: frost action, low strength, slope.	Severe: slope.
39---------------- Hodge	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
40---------------- Grable	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
41---------------- Leta	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
42---------------- Waldron	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Severe: too clayey.
43---------------- Booker	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
44---------------- Dupo	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness, shrink-swell.	Severe: flooding.	Severe: low strength, frost action.	Moderate: wetness.
45C--------------- Freeburg	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Moderate: wetness.
49D--------------- Armster	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Severe: large stones.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
49F---------------- Armster	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: large stones, slope.
56B, 56C2--------- Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Slight.
56D2--------------- Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell, slope.	Severe: shrink-swell, frost action, low strength.	Moderate: slope.
60D2--------------- Weingarten	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
64F*:						
Lily---------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.
Winfield----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
Rock outcrop.						
73F---------------- Gosport	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
74D2--------------- Snead	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: large stones, slope.
80C---------------- Winfield	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
83C---------------- Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell, slope.	Severe: shrink-swell, frost action, low strength.	Moderate: slope.
87B---------------- Wiota	Slight----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.	Slight.
98F*:						
Bethesda----------	Severe: slope.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: droughty,
Dumps.						
99*. Pits						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
9C2 Armster	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
9D2 Armster	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
10C2, 10D2 Armstrong	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
13A Auxvasse	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
15B, 15B2 Calwoods	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
16C2 Crider	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Poor: thin layer.
16D2 Crider	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Poor: thin layer.
18F*:					
Goss	Severe: slope.	Severe: seepage, slope.	Severe: slope, too clayey, large stones.	Severe: slope.	Poor: too clayey, small stones, slope.
Gasconade	Severe: thin layer, seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: area reclaim, too clayey, large stones.
Rock outcrop.					
19C, 19C2 Gorin	Severe: wetness, percs slowly.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Poor: thin layer.
20D Goss	Moderate: percs slowly, slope, large stones.	Severe: seepage, slope.	Severe: too clayey, large stones.	Moderate: slope.	Poor: too clayey, small stones.
21C, 21C2 Hatton	Severe: wetness, percs slowly.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
22C2, 22D2---------- Keswick	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
24D, 24D2----------- Lindley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
24F----------------- Lindley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
25------------------ Marion	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness.	Severe: wetness.	Poor: wetness.
27B, 27B2----------- Mexico	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
28A----------------- Moniteau	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
29------------------ Landes	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
31------------------ Haymond	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
32------------------ Cedargap	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Poor: small stones.
33------------------ Belknap	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
34------------------ Putnam	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, hard to pack, too clayey.
35C2---------------- Winfield	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
35D2---------------- Winfield	Severe: wetness.	Severe: slope, wetness.	Moderate: slope, wetness.	Moderate: slope, wetness.	Fair: too clayey, slope, wetness.
35E2, 35F2---------- Winfield	Severe: wetness, slope.	Severe: slope, wetness.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
37C2----------------- Menfro	Slight-----------	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
37D2----------------- Menfro	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
37E2, 37F2---------- Menfro	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
39------------------- Hodge	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: too sandy.
40------------------- Grable	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
41------------------- Leta	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness, thin layer.
42------------------- Waldron	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
43------------------- Booker	Severe: ponding, percs slowly.	Slight-----------	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
44------------------- Dupo	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
45C------------------ Freeburg	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: flooding, wetness.	Fair: too clayey, wetness.
49D------------------ Armster	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
49F------------------ Armster	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
56B------------------ Weller	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
56C2----------------- Weller	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
56D2----------------- Weller	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness, slope.	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
60D2----------------- Weingarten	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope, thin layer.
64F*:					
Lily----------------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: depth to rock, slope.
Winfield------------	Severe: wetness, slope.	Severe: slope, wetness.	Severe: slope.	Severe: slope.	Poor: slope.
Rock outcrop.					
73F------------------ Gosport	Severe: thin layer, seepage, percs slowly.	Severe: seepage, slope.	Severe: seepage, slope, too clayey.	Severe: slope.	Poor: area reclaim, hard to pack, slope.
74D2----------------- Snead	Severe: thin layer, seepage.	Severe: seepage, slope, wetness.	Severe: seepage, too clayey.	Moderate: seepage, slope.	Poor: area reclaim, too clayey, hard to pack.
80C------------------ Winfield	Severe: wetness.	Severe: slope, wetness.	Moderate: slope, wetness.	Moderate: slope, wetness.	Fair: too clayey, slope, wetness.
83C------------------ Weller	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness, slope.	Poor: too clayey, hard to pack.
87B------------------ Wiota	Moderate: flooding, percs slowly.	Moderate: seepage, slope.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
98F*:					
Bethesda------------	Severe: percs slowly, slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Severe: slope, unstable fill.	Poor: small stones, slope.
Dumps.					
99*. Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
9C2, 9D2------------- Armster	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
10C2, 10D2----------- Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
13A------------------ Auxvasse	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
15B, 15B2------------ Calwoods	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
16C2----------------- Crider	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
16D2----------------- Crider	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
18F*:				
Goss-----------------	Fair: shrink-swell, thin layer, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Gasconade------------	Poor: area reclaim, large stones, thin layer.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones, thin layer.
Rock outcrop.				
19C, 19C2------------ Gorin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
20D------------------ Goss	Fair: shrink-swell, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
21C, 21C2------------ Hatton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
22C2, 22D2----------- Keswick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
24D------------------ Lindley	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
24D2----------------- Lindley	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
24F: Lindley	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
25: Marion	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
27B, 27B2: Mexico	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
28A: Moniteau	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
29: Landes	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones, thin layer.
31: Haymond	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
32: Cedargap	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
33: Belknap	Fair: thin layer, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
34: Putnam	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
35C2: Winfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
35D2: Winfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
35E2: Winfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
35F2: Winfield	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
37C2: Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
37D2: Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
37E2: Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
37F2: Menfro	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
39: Hodge	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
40: Grable	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
41: Leta	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
42: Waldron	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
43: Booker	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
44: Dupo	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
45C: Freeburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
49D: Armster	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
49F: Armster	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, slope.
56B, 56C2, 56D2: Weller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
60D2: Weingarten	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, area reclaim, slope.
64F*:				
Lily	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Winfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Rock outcrop.				
73F: Gosport	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
74D2: Snead	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, large stones.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
80C------------------- Winfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
83C------------------- Weller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
87B------------------- Wiota	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
98F*:				
Bethesda-------------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Dumps.				
99*. Pits				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
9C2 Armster	Moderate: slope.	Moderate: hard to pack.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
9D2 Armster	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
10C2 Armstrong	Moderate: slope.	Moderate: wetness, hard to pack.	Slope, percs slowly, frost action.	Slope, wetness, percs slowly.	Percs slowly, wetness.	Percs slowly, wetness.
10D2 Armstrong	Severe: slope.	Moderate: wetness, hard to pack.	Slope, percs slowly, frost action.	Slope, wetness, percs slowly.	Slope, percs slowly, wetness.	Percs slowly, slope, wetness.
13A Auxvasse	Slight	Moderate: wetness.	Percs slowly	Wetness, percs slowly, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
15B, 15B2 Calwoods	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
16C2 Crider	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
16D2 Crider	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope	Slope.
18F*:						
Goss	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
Gasconade	Severe: depth to rock, seepage, slope.	Severe: large stones, thin layer.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.						
19C, 19C2 Gorin	Moderate: slope.	Moderate: thin layer, piping, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
20D Goss	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
21C, 21C2 Hatton	Moderate: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
22C2 Keswick	Moderate: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
22D2 Keswick	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
24D, 24D2, 24F Lindley	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope	Slope.
25 Marion	Slight	Moderate: wetness.	Percs slowly	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
27B, 27B2 Mexico	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
28A Moniteau	Slight	Severe: wetness.	Flooding, frost action.	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
29 Landes	Severe: seepage.	Severe: seepage, piping.	Deep to water	Favorable	Too sandy	Favorable.
31 Haymond	Moderate: seepage.	Severe: piping.	Deep to water	Flooding, erodes easily.	Erodes easily	Erodes easily.
32 Cedargap	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
33 Belknap	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
34 Putnam	Slight	Severe: wetness.	Percs slowly	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
35C2 Winfield	Moderate: seepage, slope.	Moderate: thin layer, wetness.	Frost action, slope.	Slope, erodes easily.	Erodes easily, wetness.	Erodes easily.
35D2, 35E2, 35F2 Winfield	Severe: slope.	Moderate: thin layer, wetness.	Frost action, slope.	Slope, erodes easily.	Slope, erodes easily, wetness.	Slope, erodes easily.
37C2 Menfro	Moderate: slope, seepage.	Slight	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
37D2, 37E2, 37F2 Menfro	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
39 Hodge	Severe: seepage.	Severe: piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
40 Grable	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Erodes easily, soil blowing.	Erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
41 Leta	Severe: seepage.	Severe: piping, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness	Wetness, percs slowly.
42 Waldron	Moderate: seepage.	Severe: hard to pack, wetness.	Percs slowly, frost action.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
43 Booker	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
44 Dupo	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
45C Freeburg	Moderate: slope.	Moderate: wetness.	Frost action, slope.	Wetness, slope, erodes easily.	Erodes easily, wetness.	Erodes easily.
49D, 49F Armster	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
56B, 56C2 Weller	Moderate: slope.	Moderate: hard to pack, wetness.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Percs slowly, erodes easily.
56D2 Weller	Severe: slope.	Moderate: hard to pack, wetness.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Slope, wetness, erodes easily.	Slope, percs slowly, erodes easily.
60D2 Weingarten	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
64F*:						
Lily	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
Winfield	Severe: slope.	Moderate: thin layer, wetness.	Frost action, slope.	Slope, erodes easily.	Slope, erodes easily, wetness.	Slope, erodes easily.
Rock outcrop.						
73F Gosport	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly, thin layer.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
74D2 Snead	Severe: slope.	Severe: thin layer.	Percs slowly, thin layer, slope.	Wetness, percs slowly.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
80C Winfield	Severe: slope.	Moderate: thin layer, wetness.	Frost action, slope.	Slope, erodes easily.	Slope, erodes easily, wetness.	Slope, erodes easily.
83C Weller	Severe: slope.	Moderate: hard to pack, wetness.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Slope, wetness, erodes easily.	Slope, percs slowly, erodes easily.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
87B-----------------Wiota	Moderate: seepage, slope.	Slight----------	Deep to water	Slope----------	Erodes easily	Erodes easily.
98F*: Bethesda----------	Severe: slope.	Severe: seepage, piping.	Deep to water	Slope, large stones, droughty.	Slope, large stones, slippage.	Large stones, slope, droughty.
Dumps.						
99*. Pits						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
9C2, 9D2--------- Armster	0-6	Loam--------------	CL	A-6	0	95-100	80-95	75-90	55-80	25-40	11-20
	6-69	Clay loam, clay	CL, CH	A-7	0	95-100	80-95	70-90	55-80	45-60	25-35
10C2, 10D2------- Armstrong	0-6	Loam--------------	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	6-49	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	49-66	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
13A-------------- Auxvasse	0-18	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	85-100	25-35	5-15
	18-31	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	50-65	30-40
	31-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	90-96	35-45	20-25
15B, 15B2-------- Calwoods	0-4	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	15-25
	4-8	Silty clay loam	CL, CH	A-7	0	100	100	95-100	90-100	45-55	25-35
	8-13	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-75	40-50
	13-38	Silty clay loam	CL, CH	A-7	0	100	100	95-100	95-100	45-55	25-35
	38-68	Silty clay loam, clay loam.	CL, CH	A-7	0	95-100	90-100	85-95	75-90	45-55	25-35
16C2, 16D2------- Crider	0-8	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	85-100	25-35	4-12
	8-38	Silt loam, silty clay loam.	CL, ML, CL-ML	A-7, A-6, A-4	0	100	95-100	90-100	85-100	25-42	4-20
	38-70	Silty clay, clay, silty clay loam.	CL, CH	A-7, A-6	0-5	85-100	75-100	70-100	60-100	35-65	15-40
18F*: Goss------------	0-3	Cherty silt loam	ML, CL, CL-ML	A-4	0-10	65-85	65-75	65-75	65-75	20-30	2-10
	3-11	Very cherty silty clay loam, very cherty silt loam.	GM, GC, GM-GC	A-2	10-40	40-60	35-55	30-50	25-35	20-30	2-10
	11-60	Very cherty silty clay loam, very cherty silty clay, very cherty clay.	GC, SC	A-7, A-2-7	10-45	45-70	20-65	20-50	20-45	50-70	30-40
Gasconade-------	0-9	Flaggy silty clay loam.	CL	A-6	20-50	75-90	70-85	60-75	55-65	30-40	15-25
	9-17	Flaggy silty clay, flaggy clay, very flaggy silty clay.	GC	A-2-7	20-70	45-55	40-50	30-40	20-35	55-65	35-45
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
19C, 19C2-------- Gorin	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
	8-19	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-30
	19-35	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-65	30-40
	35-60	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	80-95	70-90	30-50	12-30
20D-------------- Goss	0-8	Cherty silt loam	ML, CL, CL-ML	A-4	0-10	65-85	65-75	65-75	65-75	20-30	2-10
	8-14	Very cherty silty clay loam, very cherty silt loam.	GM, GC, GM-GC	A-2	10-40	40-60	35-55	30-50	25-35	20-30	2-10
	14-60	Cherty silty clay loam, very cherty silty clay, very cherty clay.	GC, SC	A-7, A-2-7	10-45	45-70	20-65	20-50	20-45	50-70	30-40
21C, 21C2-------- Hatton	0-8	Silt loam--------	CL-ML, CL, ML	A-4, A-6	0	100	100	90-100	80-100	25-40	5-15
	8-38	Silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	100	95-100	90-100	35-60	20-35
	38-52	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	85-95	80-90	75-85	30-45	15-25
	52-70	Silty clay loam, silt loam.	CL	A-6, A-7	0	95-100	80-95	70-90	60-85	30-45	15-25
22C2, 22D2------- Keswick	0-5	Loam-------------	CL, CL-ML	A-6, A-4	0-5	90-100	80-100	75-90	60-80	20-30	5-15
	5-39	Clay loam, clay	CH, CL	A-7	0-5	90-100	80-100	70-90	55-80	40-70	20-40
	39-60	Clay loam--------	CL	A-6	0-5	90-100	80-100	70-90	55-80	30-40	15-25
24D-------------- Lindley	0-7	Loam-------------	CL	A-6	0	95-100	90-100	85-95	50-65	25-35	10-15
	7-36	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	12-20
	36-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15
24D2------------- Lindley	0-5	Clay loam--------	CL	A-6	0	95-100	90-100	85-95	55-75	30-40	15-20
	5-30	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	12-20
	30-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15
24F-------------- Lindley	0-5	Loam-------------	CL	A-6	0	95-100	90-100	85-95	50-65	25-35	10-15
	5-30	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	12-20
	30-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15
25--------------- Marion	0-11	Silt loam--------	ML, CL	A-4, A-6	0	100	100	90-100	90-100	30-40	5-15
	11-27	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	50-65	30-40
	27-60	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-45	20-25
27B, 27B2-------- Mexico	0-8	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
	8-14	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-35
	14-21	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-75	30-45
	21-46	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-35
	46-60	Silty clay loam, clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-100	40-65	15-40

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
28A--------------- Moniteau	0-19	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	85-100	25-35	5-15
	19-56	Silty clay loam	CL	A-6, A-7	0	100	100	85-100	80-95	30-45	15-25
	56-60	Silt loam, silty clay loam.	CL-ML, CL, ML	A-4, A-6	0	100	100	85-100	75-100	25-40	5-15
29--------------- Landes	0-12	Loam-------------	CL, CL-ML	A-4, A-6	0	100	90-100	85-100	50-75	20-35	5-15
	12-60	Loam, fine sandy loam, loamy fine sand.	SM, CL-ML, SC, SM-SC	A-4, A-2-4	0	100	85-100	70-100	15-60	<25	NP-10
31--------------- Haymond	0-7	Silt loam--------	ML	A-4	0	100	100	90-100	80-90	27-36	4-10
	7-60	Fine sandy loam, silt loam, loam.	SM, ML	A-4	0	95-100	90-100	80-100	35-90	27-36	4-10
32--------------- Cedargap	0-7	Loam-------------	ML	A-4	0-5	90-100	85-95	75-95	70-95	25-35	3-9
	7-38	Very cherty loam, very cherty loam, cherty loam.	SM, GM, ML	A-1, A-2, A-4	2-15	40-85	25-75	25-70	20-65	25-35	3-9
	38-60	Extremely cherty silty clay loam, extremely cherty loam, very cherty loam.	GC, GM-GC	A-2-4, A-2-6, A-1-b	5-20	25-50	20-45	15-40	15-35	20-35	5-20
33--------------- Belknap	0-13	Silt loam--------	ML, CL, CL-ML	A-4	0	100	95-100	90-100	80-100	20-30	2-8
	13-60	Silt loam--------	ML, CL-ML, CL	A-4, A-6	0	100	95-100	90-100	80-100	20-35	NP-12
34--------------- Putnam	0-7	Silt loam--------	CL, ML	A-6, A-4	0	100	100	90-100	85-100	30-40	5-15
	7-14	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	30-40	5-15
	14-25	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	60-70	35-45
	25-41	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	90-100	50-65	25-40
	41-60	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	20-30
35C2, 35D2, 35E2, 35F2------------ Winfield	0-7	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	25-40	10-20
	7-45	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	20-25
	45-60	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-35	5-15
37C2, 37D2, 37E2, 37F2------------ Menfro	0-6	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	25-35	11-20
	6-12	Silt loam, silty clay loam.	CL	A-6	0	100	100	95-100	90-100	25-40	11-20
	12-50	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	20-25
	50-68	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-35	5-15
39--------------- Hodge	0-8	Fine sand--------	SM	A-2, A-4	0	100	100	70-85	25-45	---	NP
	8-53	Stratified fine sand to loamy fine sand.	SM	A-2, A-4	0	100	100	70-85	25-45	---	NP
	53-60	Silt loam--------	CL-ML, CL, ML	A-4	0	100	100	85-95	50-65	<25	NP-10

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
40---------------- Grable	0-8	Very fine sandy loam.	CL-ML, ML	A-4	0	100	100	80-95	80-95	<25	NP-5
	8-22	Very fine sandy loam, silt loam.	CL, CL-ML	A-4	0	100	100	80-95	80-95	20-30	5-10
	22-34	Loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	65-80	5-35	<20	NP-5
	34-60	Stratified loamy fine sand to silt loam.	CL, ML, SM, SC	A-4, A-2-4	0	100	100	70-90	25-70	20-30	NP-10
41---------------- Leta	0-11	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-95	35-45	15-25
	11-25	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	90-95	35-50	20-35
	25-44	Stratified very fine sandy loam to silt loam.	CL, CL-ML, ML	A-4, A-6	0	100	100	90-100	50-90	20-35	5-15
	44-72	Fine sand, loamy fine sand.	SM	A-2-4	0	100	100	60-80	20-30	<25	NP
42---------------- Waldron	0-11	Silty clay--------	CL, CH	A-7	0	100	100	95-100	90-100	45-65	30-45
	11-48	Stratified silty clay loam to silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	40-65	20-45
	48-75	Stratified very fine sandy loam to silt loam.	CL, CL-ML	A-4, A-6	0	100	100	85-95	50-65	25-35	5-15
43---------------- Booker	0-20	Silty clay--------	CL, CH	A-7	0	100	100	95-100	95-100	45-75	30-45
	20-75	Clay--------------	CH	A-7	0	100	100	100	95-100	65-85	40-55
44---------------- Dupo	0-8	Silt loam---------	ML, CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-35	1-15
	8-39	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-35	5-15
	39-68	Silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	100	98-100	35-55	15-30
45C--------------- Freeburg	0-5	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	90-100	90-100	15-35	5-15
	5-11	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	85-100	85-100	30-45	15-25
	11-26	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	85-100	70-100	30-45	15-25
	26-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	85-100	85-100	30-45	15-25
49D, 49F--------- Armster	0-9	Cobbly loam-------	CL	A-7	25-40	90-95	80-90	70-90	55-80	40-50	25-35
	9-58	Clay loam, clay	CL, CH	A-7	0	95-100	80-95	70-90	55-80	45-55	25-35
	58-72	Clay loam, loam	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	30-45	15-25
56B, 56C2, 56D2-- Weller	0-10	Silt loam---------	ML, CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	10-53	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-65	30-40
	53-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	30-55	10-30

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
60D2-------------- Weingarten	0-6	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	20-35	5-15
	6-28	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	95-100	95-100	95-100	30-45	11-25
	28-43	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	95-100	95-100	95-100	25-40	7-18
	43-65	Silty clay, silty clay loam.	CL, CH	A-7	0-5	95-100	75-100	75-100	60-90	45-65	25-40
64F*:											
Lily------------	0-6	Loam-------------	SM, SM-SC	A-4, A-2	0-5	90-100	75-100	60-85	30-55	15-25	NP-5
	6-24	Loam, sandy clay loam.	SC, CL, SM-SC	A-4, A-6	0-5	90-100	75-100	75-95	40-75	20-35	5-15
	24-32	Gravelly sandy clay loam, sandy clay loam, loam.	SC, CL, SM-SC	A-4, A-6	0-5	90-100	75-90	75-85	40-70	20-35	5-15
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Winfield--------	0-5	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	25-40	10-20
	5-37	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	20-25
	37-60	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-35	5-15
Rock outcrop.											
73F-------------- Gosport	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	90-100	90-100	70-100	25-40	5-15
	9-33	Clay, silty clay, silty clay loam.	CH	A-7	0	100	90-100	90-100	85-100	50-65	35-50
	33	Weathered bedrock	---	---	---	---	---	---	---	---	---
74D2------------- Snead	0-10	Silty clay loam	CL	A-6, A-7	0-10	90-100	90-100	90-100	80-95	35-45	15-25
	10-24	Silty clay, clay	CH, CL	A-7	0-10	90-100	90-100	90-100	80-100	45-60	25-40
	24	Weathered bedrock	---	---	---	---	---	---	---	---	---
80C-------------- Winfield	0-13	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	25-40	10-20
	13-60	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	20-25
83C-------------- Weller	0-10	Silt loam--------	ML, CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	10-41	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-65	30-40
	41-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	30-55	10-30
87B-------------- Wiota	0-18	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	90-95	25-35	5-15
	18-46	Silty clay loam	CL	A-7	0	100	100	95-100	90-95	40-50	15-25
	46-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	95-100	90-95	30-50	15-30
98F*:											
Bethesda--------	0-6	Shaly silty clay loam.	CL, SC, GC	A-6, A-7	5-20	65-90	50-80	45-80	35-75	35-50	12-24
	6-60	Very shaly silty clay loam, very shaly silt loam.	GM, GC, ML, CL	A-4, A-6, A-7, A-2	10-30	40-80	25-65	20-65	18-60	24-50	3-23
Dumps.											
99*. Pits											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
9C2, 9D2	0-6	15-27	1.35-1.50	0.6-2.0	0.17-0.20	4.5-7.3	Moderate	0.37	5	6	1-2
Armster	6-69	35-48	1.35-1.45	0.2-0.6	0.10-0.18	4.5-7.3	High	0.37			
10C2, 10D2	0-6	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate	0.32	3	6	2-3
Armstrong	6-49	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High	0.32			
	49-66	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.3	Moderate	0.32			
13A	0-18	8-16	1.30-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low	0.43	3	5	.5-1
Auxvasse	18-31	45-60	1.35-1.50	<0.06	0.09-0.11	4.5-7.8	High	0.43			
	31-60	25-40	1.35-1.50	0.2-0.6	0.18-0.20	4.5-7.8	Moderate	0.43			
15B, 15B2	0-4	15-27	1.40-1.50	0.6-2.0	0.22-0.24	4.5-7.3	Low	0.37	3	6	1-2
Calwoods	4-8	27-36	1.35-1.45	0.2-0.6	0.18-0.20	4.5-6.5	Moderate	0.37			
	8-13	45-60	1.30-1.40	<0.06	0.11-0.13	4.5-5.5	High	0.37			
	13-38	28-39	1.35-1.45	<0.06	0.14-0.18	4.5-7.3	Moderate	0.37			
	38-68	28-35	1.35-1.50	<0.06	0.18-0.20	5.6-7.3	Moderate	0.37			
16C2, 16D2	0-8	15-27	1.20-1.40	0.6-2.0	0.19-0.23	5.1-7.3	Low	0.32	5	6	2-4
Crider	8-38	18-35	1.20-1.45	0.6-2.0	0.18-0.23	5.1-7.3	Low	0.28			
	38-70	30-60	1.20-1.55	0.6-2.0	0.12-0.18	4.5-6.5	Moderate	0.28			
18F*:											
Goss	0-3	10-27	1.10-1.30	2.0-6.0	0.06-0.17	4.5-6.5	Low	0.24	2	8	.5-2
	3-11	20-30	1.10-1.30	2.0-6.0	0.06-0.10	4.5-6.0	Low	0.10			
	11-60	35-60	1.30-1.50	0.6-2.0	0.04-0.09	4.5-6.5	Moderate	0.10			
Gasconade	0-9	35-40	1.35-1.50	0.6-2.0	0.10-0.12	6.1-7.8	Moderate	0.20	2	8	2-4
	9-17	35-60	1.45-1.70	0.2-0.6	0.05-0.07	6.1-7.8	Moderate	0.20			
	17	---	---	---	---	---	-------------	----			
Rock outcrop.											
19C, 19C2	0-8	12-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Moderate	0.43	3	6	.5-2
Gorin	8-19	27-42	1.30-1.45	0.06-0.6	0.18-0.20	4.5-6.0	Moderate	0.32			
	19-35	35-60	1.30-1.40	0.06-0.2	0.11-0.16	4.5-6.0	High	0.32			
	35-60	27-40	1.30-1.45	0.2-0.6	0.18-0.20	4.5-6.0	Moderate	0.32			
20D	0-8	10-27	1.10-1.30	2.0-6.0	0.06-0.17	4.5-6.5	Low	0.24	2	8	.5-2
Goss	8-14	20-30	1.10-1.30	2.0-6.0	0.06-0.10	4.5-6.0	Low	0.10			
	14-60	35-60	1.30-1.50	0.6-2.0	0.04-0.09	4.5-6.5	Moderate	0.10			
21C, 21C2	0-8	12-27	1.35-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Low	0.43	3	6	1-2
Hatton	8-38	27-48	1.30-1.40	0.06-0.2	0.11-0.18	4.5-5.5	Moderate	0.32			
	38-52	25-35	1.45-1.65	<0.06	0.10-0.15	4.5-5.5	Moderate	0.43			
	52-70	25-35	1.35-1.50	0.06-0.2	0.11-0.18	5.1-6.0	Moderate	0.43			
22C2, 22D2	0-5	22-27	1.45-1.50	0.6-2.0	0.17-0.22	4.5-7.3	Moderate	0.37	3	6	1-2
Keswick	5-39	35-60	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.5	High	0.37			
	39-60	30-40	1.60-1.75	0.2-0.6	0.12-0.16	4.5-7.8	Moderate	0.37			
24D	0-7	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low	0.32	5	6	1-2
Lindley	7-36	25-35	1.40-1.60	0.2-0.6	0.14-0.18	4.5-6.5	Moderate	0.32			
	36-60	18-32	1.45-1.65	0.2-0.6	0.12-0.16	6.1-7.8	Moderate	0.32			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
24D2-------------- Lindley	0-5	27-35	1.30-1.40	0.2-0.6	0.14-0.18	4.5-7.3	Moderate-----	0.32	4	6	.5-1
	5-30	25-35	1.40-1.60	0.2-0.6	0.14-0.18	4.5-6.5	Moderate-----	0.32			
	30-60	18-32	1.45-1.65	0.2-0.6	0.12-0.16	6.1-7.8	Moderate-----	0.32			
24F--------------- Lindley	0-5	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low----------	0.32	5	6	1-2
	5-30	25-35	1.40-1.60	0.2-0.6	0.14-0.18	4.5-6.5	Moderate-----	0.32			
	30-60	18-32	1.45-1.65	0.2-0.6	0.12-0.16	6.1-7.8	Moderate-----	0.32			
25---------------- Marion	0-11	12-27	1.30-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	6	1-2
	11-27	48-60	1.30-1.65	<0.06	0.11-0.13	3.6-5.5	High---------	0.32			
	27-60	30-40	1.30-1.55	0.06-0.2	0.15-0.17	3.6-6.0	Moderate-----	0.43			
27B, 27B2--------- Mexico	0-8	15-27	1.20-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.43	3	6	2-4
	8-14	35-50	1.25-1.45	0.2-0.6	0.12-0.16	4.5-6.5	High---------	0.32			
	14-21	50-60	1.25-1.45	<0.06	0.08-0.12	4.5-6.0	High---------	0.32			
	21-46	35-50	1.25-1.45	0.2-0.6	0.12-0.16	5.1-7.3	High---------	0.32			
	46-60	27-50	1.25-1.45	<0.6	0.12-0.18	5.1-7.3	High---------	0.32			
28A--------------- Moniteau	0-19	18-27	1.20-1.40	0.6-2.0	0.21-0.23	5.1-7.3	Low----------	0.43	5	6	1-2
	19-56	27-35	1.30-1.50	0.2-0.6	0.18-0.20	4.5-6.0	Moderate-----	0.43			
	56-60	18-30	1.25-1.45	0.2-0.6	0.20-0.22	4.5-6.5	Low----------	0.43			
29---------------- Landes	0-12	10-22	1.20-1.40	0.6-6.0	0.20-0.22	6.1-8.4	Low----------	0.32	4	5	1-2
	12-60	5-18	1.60-1.70	2.0-6.0	0.10-0.15	5.6-8.4	Low----------	0.32			
31---------------- Haymond	0-7	10-18	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	5	5	1-3
	7-60	10-18	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.37			
32---------------- Cedargap	0-7	15-27	1.20-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	5	6	1-4
	7-38	12-30	1.30-1.50	0.6-2.0	0.10-0.15	5.6-7.3	Low----------	0.24			
	38-60	18-35	1.40-1.55	0.6-2.0	0.04-0.12	5.6-7.3	Low----------	0.10			
33---------------- Belknap	0-13	8-18	1.30-1.50	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.37	5	5	1-3
	13-60	8-25	1.25-1.50	0.6-2.0	0.20-0.22	4.5-6.0	Low----------	0.37			
34---------------- Putnam	0-7	12-27	1.30-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	6	.5-3
	7-14	12-27	1.30-1.50	0.6-2.0	0.20-0.22	4.5-6.5	Low----------	0.43			
	14-25	48-60	1.20-1.40	<0.06	0.09-0.11	3.6-5.5	High---------	0.32			
	25-41	35-48	1.25-1.45	0.06-0.2	0.12-0.16	3.6-5.5	High---------	0.43			
	41-60	27-35	1.30-1.50	0.06-0.2	0.14-0.18	5.1-6.0	Moderate-----	0.43			
35C2, 35D2, 35E2, 35F2------------ Winfield	0-7	20-27	1.30-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	5	6	.5-2
	7-45	27-35	1.30-1.50	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	45-60	20-27	1.30-1.50	0.6-2.0	0.20-0.22	5.1-6.0	Low----------	0.37			
37C2, 37D2, 37E2, 37F2------------ Menfro	0-6	18-27	1.25-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.37	5	6	.5-2
	6-12	25-30	1.30-1.45	0.6-2.0	0.18-0.22	5.1-7.3	Moderate-----	0.37			
	12-50	27-33	1.35-1.50	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.37			
	50-68	8-20	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.37			
39---------------- Hodge	0-8	5-12	1.40-1.50	6.0-20	0.07-0.10	6.6-7.8	Low----------	0.15	5	1	.5-1
	8-53	5-12	1.40-1.55	6.0-20	0.07-0.10	6.6-7.8	Low----------	0.15			
	53-60	10-20	1.40-1.50	2.0-6.0	0.16-0.20	6.6-7.8	Low----------	0.43			
40---------------- Grable	0-8	15-20	1.20-1.30	0.6-2.0	0.22-0.24	7.4-8.4	Low----------	0.32	4	3	1-3
	8-22	10-20	1.20-1.40	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43			
	22-34	5-10	1.20-1.40	6.0-20	0.04-0.08	7.4-8.4	Low----------	0.17			
	34-60	5-20	1.20-1.40	2.0-6.0	0.08-0.20	7.4-8.4	Low----------	0.32			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
41----------------- Leta	0-11	30-40	1.30-1.45	0.2-0.6	0.21-0.23	6.6-7.8	Moderate-----	0.28	5	4L	2-4
	11-25	35-45	1.30-1.50	0.06-0.2	0.13-0.18	6.6-7.8	High---------	0.28			
	25-44	10-27	1.30-1.50	0.6-2.0	0.17-0.22	7.4-7.8	Low----------	0.28			
	44-72	5-10	1.30-1.50	6.0-20	0.05-0.08	7.4-8.4	Low----------	0.10			
42----------------- Waldron	0-11	40-50	1.35-1.45	0.06-0.2	0.12-0.14	6.6-7.8	High---------	0.32	5	4	2-4
	11-48	35-50	1.30-1.50	0.06-0.2	0.10-0.18	6.6-8.4	High---------	0.32			
	48-75	18-27	1.40-1.50	0.6-2.0	0.18-0.20	7.4-8.4	Low----------	0.43			
43----------------- Booker	0-20	40-70	1.30-1.50	<0.06	0.12-0.14	5.6-7.3	Very high----	0.28	5	4	1-3
	20-75	60-75	1.30-1.45	<0.06	0.09-0.11	5.6-7.3	Very high----	0.28			
44----------------- Dupo	0-8	10-18	1.25-1.45	0.6-2.0	0.22-0.24	5.6-8.4	Low----------	0.37	4	5	1-2
	8-39	10-18	1.30-1.50	0.6-2.0	0.20-0.22	5.6-8.4	Low----------	0.37			
	39-68	35-45	1.35-1.60	0.06-0.2	0.08-0.19	6.6-7.8	High---------	0.37			
45C---------------- Freeburg	0-5	12-25	1.20-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	5	6	5-2
	5-11	25-35	1.40-1.50	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.37			
	11-26	27-35	1.40-1.50	0.2-0.6	0.15-0.19	4.5-5.5	Moderate-----	0.37			
	26-60	25-32	1.35-1.50	0.2-0.6	0.16-0.20	4.5-7.3	Moderate-----	0.37			
49D, 49F---------- Armster	0-9	30-35	1.35-1.45	0.2-0.6	0.12-0.18	4.5-7.3	Moderate-----	0.28	5	8	.5-2
	9-58	35-40	1.35-1.45	0.2-0.6	0.12-0.18	4.5-7.3	High---------	0.37			
	58-72	25-40	1.30-1.40	0.2-0.6	0.12-0.15	6.6-7.8	Moderate-----	0.37			
56B, 56C2, 56D2-- Weller	0-10	16-27	1.35-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	6	1-2
	10-53	28-48	1.35-1.50	0.06-0.2	0.12-0.18	4.5-6.0	High---------	0.43			
	53-60	25-40	1.40-1.55	0.2-0.6	0.18-0.20	5.1-6.0	High---------	0.43			
60D2-------------- Weingarten	0-6	10-27	1.30-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.37	5	5	1-2
	6-28	20-35	1.30-1.60	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	28-43	15-30	1.50-1.70	0.2-0.6	0.10-0.15	5.1-6.5	Low----------	0.37			
	43-65	35-60	1.30-1.50	0.6-2.0	0.05-0.10	5.1-7.8	Moderate-----	0.24			
64F*:											
Lily--------------	0-6	5-18	1.20-1.40	2.0-6.0	0.13-0.18	3.6-6.5	Low----------	0.28	2	3	.5-2
	6-24	18-35	1.20-1.40	2.0-6.0	0.12-0.18	3.6-5.5	Low----------	0.28			
	24-32	20-35	1.25-1.35	2.0-6.0	0.12-0.16	3.6-5.5	Low----------	0.28			
	32	---	---	---	---	---	--------------	----			
Winfield----------	0-5	20-27	1.30-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	5	6	.5-2
	5-37	27-35	1.30-1.50	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
	37-60	20-27	1.30-1.50	0.6-2.0	0.20-0.22	5.1-6.0	Low----------	0.37			
Rock outcrop.											
73F---------------- Gosport	0-9	18-27	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.5	Low----------	0.43	3	6	1-2
	9-33	36-60	1.50-1.60	<0.06	0.12-0.14	3.6-5.5	High---------	0.32			
	33	---	---	---	---	---	--------------	----			
74D2-------------- Snead	0-10	27-40	1.30-1.40	0.2-0.6	0.21-0.24	6.1-7.3	Moderate-----	0.37	3	7	2-4
	10-24	40-60	1.25-1.35	0.06-0.2	0.12-0.14	6.6-8.4	High---------	0.32			
	24	---	---	---	---	---	--------------	----			
80C---------------- Winfield	0-13	20-27	1.30-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	5	6	.5-2
	13-60	27-35	1.30-1.50	0.6-2.0	0.18-0.20	4.5-6.0	Moderate-----	0.37			
83C---------------- Weller	0-10	16-27	1.35-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	6	1-2
	10-41	28-48	1.35-1.50	0.06-0.2	0.12-0.18	4.5-6.0	High---------	0.43			
	41-60	25-40	1.40-1.55	0.2-0.6	0.18-0.20	5.1-6.0	High---------	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
87B-------------- Wiota	0-18	20-27	1.30-1.35	0.6-2.0	0.21-0.23	5.1-7.3	Low-----------	0.32	5	6	3-4
	18-46	30-36	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	46-60	25-34	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43			
98F*:											
Bethesda--------	0-6	27-35	1.45-1.65	0.2-0.6	0.05-0.16	3.6-5.5	Low-----------	0.28	5	8	<.5
	6-60	18-35	1.60-1.90	0.2-0.6	0.04-0.10	3.6-5.5	Low-----------	0.32			
Dumps.											
99*. Pits											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
9C2, 9D2----------- Armster	C	None---------	---	---	3.0-5.0	Perched	Nov-May	>60	---	Moderate	High-----	Moderate.
10C2, 10D2--------- Armstrong	C	None---------	---	---	1.0-3.0	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
13A---------------- Auxvasse	D	Rare---------	---	---	1.0-2.0	Perched	Nov-May	>60	---	Moderate	High-----	High.
15B, 15B2---------- Calwoods	D	None---------	---	---	1.0-2.5	Perched	Nov-Apr	>60	---	High-----	High-----	High.
16C2, 16D2--------- Crider	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
18F*:												
Goss--------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Gasconade---------	D	None---------	---	---	>6.0	---	---	4-20	Hard	Moderate	High-----	Low.
Rock outcrop.												
19C, 19C2---------- Gorin	C	None---------	---	---	2.0-4.0	Perched	Nov-Apr	>60	---	High-----	High-----	Moderate.
20D---------------- Goss	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
21C, 21C2---------- Hatton	C	None---------	---	---	2.0-3.0	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
22C2, 22D2--------- Keswick	C	None---------	---	---	1.0-3.0	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
24D, 24D2, 24F----- Lindley	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
25----------------- Marion	D	None---------	---	---	1.0-2.0	Perched	Nov-May	>60	---	Moderate	High-----	High.
27B, 27B2---------- Mexico	D	None---------	---	---	1.0-2.5	Perched	Nov-May	>60	---	Moderate	High-----	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
28A---------------- Moniteau	C/D	Occasional	Brief------	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	High-----	High.
29---------------- Landes	B	Frequent----	Brief------	Nov-May	>6.0	---	---	>60	---	Moderate	Low------	Low.
31---------------- Haymond	B	Occasional	Brief------	Nov-May	>6.0	---	---	>60	---	High-----	Low------	Low.
32---------------- Cedargap	B	Frequent----	Very brief	Nov-May	>6.0	---	---	>60	---	Moderate	Low------	Low.
33---------------- Belknap	C	Occasional	Brief to long.	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	High.
34---------------- Putnam	D	None---------	---	---	0.5-1.5	Perched	Nov-May	>60	---	Moderate	High-----	High.
35C2, 35D2, 35E2, 35F2------------- Winfield	B	None---------	---	---	2.5-4.0	Perched	Nov-May	>60	---	High-----	Moderate	Moderate.
37C2, 37D2, 37E2, 37F2------------- Menfro	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Low------	Moderate.
39---------------- Hodge	A	Frequent----	Brief------	Nov-May	>6.0	---	---	>60	---	Low------	Low------	Low.
40---------------- Grable	B	Rare---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
41---------------- Leta	C	Rare---------	---	---	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
42---------------- Waldron	D	Rare---------	---	---	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
43---------------- Booker	D	Rare---------	---	---	+.5-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Moderate.
44---------------- Dupo	C	Rare---------	---	---	1.5-3.5	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
45C---------------- Freeburg	C	Rare---------	---	---	1.5-3.0	Perched	Nov-May	>60	---	High-----	High-----	High.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
49D, 49F----------- Armster	C	None---------	---	---	3.0-5.0	Perched	Nov-May	>60	---	Moderate	High-----	Moderate.
56B, 56C2, 56D2--- Weller	C	None---------	---	---	2.0-4.0	Perched	Nov-May	>60	---	High-----	High-----	High.
60D2--------------- Weingarten	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
64F*:												
Lily--------------	B	None---------	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate	High.
Winfield----------	B	None---------	---	---	2.5-4.0	Perched	Nov-May	>60	---	High-----	Moderate	Moderate.
Rock outcrop.												
73F---------------- Gosport	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	High.
74D2--------------- Snead	D	None---------	---	---	2.0-3.0	Perched	Nov-May	20-40	Soft	Moderate	High-----	Low.
80C---------------- Winfield	B	None---------	---	---	2.5-4.0	Perched	Nov-May	>60	---	High-----	Moderate	Moderate.
83C---------------- Weller	C	None---------	---	---	2.0-4.0	Perched	Nov-May	>60	---	High-----	High-----	High.
87B---------------- Wiota	B	Rare---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
98F*:												
Bethesda----------	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	High.
Dumps.												
99*. Pits												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Armster	Fine, montmorillonitic, mesic Mollic Hapludalfs
Armstrong	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Auxvasse	Fine, montmorillonitic, mesic Aeric Albaqualfs
Belknap	Coarse-silty, mixed, acid, mesic Aeric Fluvaquents
Bethesda	Loamy-skeletal, mixed, acid, mesic Typic Udorthents
Booker	Very fine, montmorillonitic, mesic Vertic Haplaquolls
Calwoods	Fine, montmorillonitic, mesic Aeric Ochraqualfs
Cedargap	Loamy-skeletal, mixed, mesic Cumulic Hapludolls
Crider	Fine-silty, mixed, mesic Typic Paleudalfs
Dupo	Coarse-silty over clayey, mixed, nonacid, mesic Aquic Udifluvents
Freeburg	Fine-silty, mixed, mesic Aquic Hapludalfs
Gasconade	Clayey-skeletal, mixed, mesic Lithic Hapludolls
Gorin	Fine, montmorillonitic, mesic Aquic Hapludalfs
Gosport	Fine, illitic, mesic Typic Dystrochrepts
Goss	Clayey-skeletal, mixed, mesic Typic Paleudalfs
Grable	Coarse-silty over sandy or sandy-skeletal, mixed (calcareous), mesic Mollic Udifluvents
Hatton	Fine, montmorillonitic, mesic Typic Hapludalfs
Haymond	Coarse-silty, mixed, nonacid, mesic Typic Udifluvents
Hodge	Mixed, mesic Typic Udipsamments
Keswick	Fine, montmorillonitic, mesic Aquic Hapludalfs
Landes	Coarse-loamy, mixed, mesic Fluventic Hapludolls
Leta	Clayey over loamy, montmorillonitic, mesic Fluvaquentic Hapludolls
Lily	Fine-loamy, siliceous, mesic Typic Hapludults
Lindley	Fine-loamy, mixed, mesic Typic Hapludalfs
Marion	Fine, montmorillonitic, mesic Albaquic Hapludalfs
Menfro	Fine-silty, mixed, mesic Typic Hapludalfs
Mexico	Fine, montmorillonitic, mesic Udollic Ochraqualfs
Moniteau	Fine-silty, mixed, mesic Typic Ochraqualfs
Putnam	Fine, montmorillonitic, mesic Mollic Albaqualfs
Snead	Fine, mixed, mesic Aquic Hapludolls
*Waldron	Fine, montmorillonitic (calcareous), mesic Aeric Fluvaquents
Weingarten	Fine-silty, mixed, mesic Typic Hapludalfs
Weller	Fine, montmorillonitic, mesic Aquic Hapludalfs
Winfield	Fine-silty, mixed, mesic Typic Hapludalfs
Wiota	Fine-silty, mixed, mesic Typic Argiudolls

TABLE 19.--STRATIGRAPHIC UNITS IN CALLAWAY COUNTY

Time stratigraphic units			Age (years before present)	Rock stratigraphic units		Soil stratigraphic units
System	Series	Stage		Formation	Lithology	
Quaternary	Holocene (Recent)		0-14,000	Unnamed colluvium and alluvium	Sand, silt, clay	Holocene Soil
	Pleistocene	Wisconsian	14,000-22,000	Peoria Loess	Silt	Farmdale Soil
		Sangamonian	28,000-125,000	Roxana Silt Unnamed colluvium and alluvium	Silt Gravel, sand, silt, clay	Late Sangamon Soil Middle Sangamon Soil Early Sangamon Soil
		Illinoian	135,000	Loveland Silt	Silt	
		Yarmouthian				Yarmouth Soil
		Pre-Illinoian	600,000	McCredie Formation	Loam	
		Preglacial	2,000,000	Whippoorwill Formation	Loam, gravel	
Pennsylvanian			290,000,000 305,000,000	Marmaton Group Cherokee Group	Sandstone, shale, coal Sandstone, shale, clay, coal Limestone, chert, conglomerate	
Mississippian			325,000,000 347,000,000	Burlington Limestone Chouteau Group	Limestone, chert Limestone, chert	
Devonian			360,000,000 370,000,000	Snyder Creek Formation Callaway Formation	Shale and sandstone Limestone	
Ordovician			more than 435,000,000	St. Peter Sandstone Powell Dolomite Cotter Dolomite Jefferson City Dolomite	Sandstone Dolomite Dolomite Dolomite	

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